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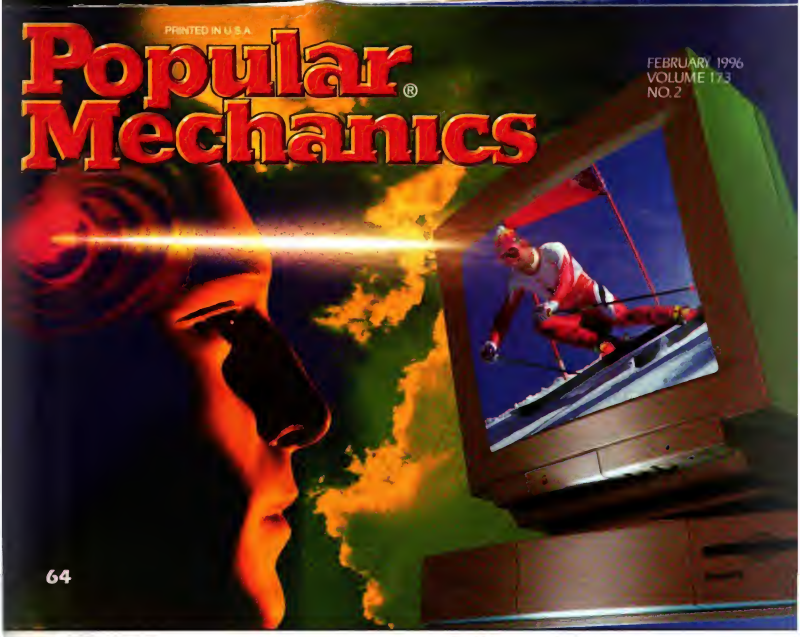
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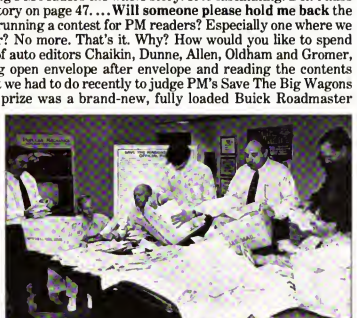
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PM cover illustration by Paul DiMare

EDITOR'S NOTES

● When the federal government recently declassified 35 years' worth of data gleaned from a whole generation of intelligence satellites, I was surprised at the scant attention the event received. *The New York Times* ran a brief story, as did the weekly newsmagazines. But here was the CIA, DIA, NSA and a score of other alphabet agencies spilling their guts and no one cared. Well, we did. So we dispatched Phil Chien, a regular contributor to our science/technology coverage, to bring PM readers the whole story. It *is* fascinating. Don't miss this month's cover story on page 47. ... **Will someone please hold me back** the next time I suggest running a contest for PM readers? Especially one where we give away a free car? No more. That's it. Why? How would you like to spend days with the likes of auto editors Chaikin, Dunne, Allen, Oldham and Gromer, eating pizza, tearing open envelope after envelope and reading the contents therein? That's what we had to do recently to judge PM's Save The Big Wagons contest, where the prize was a brand-new, fully loaded Buick Roadmaster Estate wagon. Almost 10,000 entries later, we had finalists. Then, after a trip to Buick headquarters and lots of consideration with Buick Vice President and General Manager Ed Mertz, we had a winner. And Joan Zettel of Breckenridge, Minnesota, is one very happy lady. Did you enter? No? You missed it? Don't worry, we have a new contest in the planning stages right now—oh no! ... **According to Boating Editor Joe Skorupa, jet boats** are taking over the world. Well, at least the boating industry. Right now, just about half of all boats sold are the small, affordable jet-powered craft that exploded on the market just a few years ago. Our report about what's new on the water for '96 begins on page 68. But if you're a traditionalist, don't worry. Half the boats sold are still the conventional inboard, outboard or I/O types that we've all loved all these years. And we thoroughly cover those too. ... **For years, aliens in science-fiction movies** have been controlling things with their minds—things like humans, rocket-ship motors, spoons and stuff like that. And while we haven't quite reached that stage, we can now control videogame play with our mind. Hey, I'm serious. I, too, was skeptical. But our Electronics Editor, Frank Vizard, tried it and swears that it's true. The real story begins on page 64. Who knows where it ends? ... **Is there anything that beautifies a home more** than a gleaming hardwood floor? I can't think of anything. If you can't either, check out our step-by-step guide to installing one that begins on page 78. Till next time.



Pizza and entries, pizza and entries.

Joe Oldham

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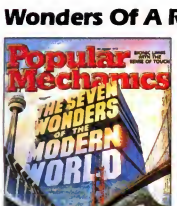
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LETTERS

Wonders Of A Real World



I enjoyed your article on the seven wonders of the modern world. Of particular interest was the Itaipu Dam. My first encounter with it was a year or so ago, when I discovered a CD by Philip Glass called "Itaipu." The liner notes tell of Glass visiting South America, where he was awed by the grandeur of the dam. Upon his return to America, he translated his impressions into a stunning and vivid modern opera. Some of the operatic voices use words taken from the Guarani, a people indigenous to the area. Sadly, I read in a recent news story that these people are being driven from their homes, and are impoverished by overdevelopment. Many of them "escape" by moving into Brazilian shantytowns or committing suicide. Let us not forget that next to every great modern wonder stands human misery and suffering.

AARON WOODIN
WHITE PLAINS, NY

Plans to build the Golden Gate Bridge across the entrance to San Francisco Bay met with a good deal of opposition from people, myself included, who feared the bridge would detract from the beauty of the setting. That fear was put to rest for this reader one evening at dusk as I rode the boat across the bay. Nature's work of art, a glorious sunset, was spectacularly framed by man's work, the Golden Gate Bridge. The Japanese have a saying that utility is beauty, and the bridge certainly turned out a winner both from a practical and an aesthetic viewpoint.

ROBERT W. BOORMAN
PHOENIX, AZ

Letters are subject to editing for length, style and format.

Power Of Ten

The letter from John N. Simien and the statement from Stanley L. Lightner about the metric system address a very serious problem facing U.S. industry. Billions of dollars are spent on dual standard products. This is why American-made goods are hardly competitive in foreign markets. Your reply is detrimental and puts you in the same league as the geriatric population that doesn't want to understand it.

ADRIAN A. JARVIS
NEW YORK, NY

You are very bold, announcing your dislike for the metric system. I am a mathematics instructor and have to deal with it from time to time, but I also don't like it and never have. Good for you for taking a stand.

ED DYE
ATHENS, GA

Lightner's letter was right on the money. Your response was an outrage. I cannot, in the farthest reaches of my imagination, come up with a viable answer to what's not to like about the metric system, vis-à-vis the ridiculous English system that still lingers. I can only assume that you are totally unfamiliar with it, and that you resist change to a greater degree than is healthy. The only other explanation is outright stupidity.

B.G. KIDDER JR.
SAN ANTONIO, TX

You are the second scientific-type guy in the universe who does not like the metric system!

M.P. PRONGUE
VIA INTERNET

It's no wonder that the United States hasn't gone metric, when we have the editor of a leading publication bad-mouthing it. Get real. The U.S. should get with the rest of the world.

HARVEY WILKE
VIA INTERNET

Lightner has allowed his displeasure with our American way of measurement to obscure the facts of our successful system. If he's so distressed about it, he really should "go global" and move the hell out of our dear old U.S. of A.

GEORGE A. HILLMAN
MORRISTON, FL

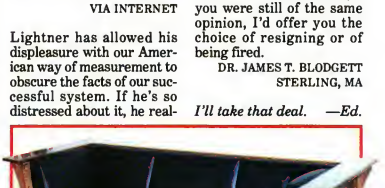
I don't care whether you like the metric system or not. The reality is that it's here, and we can either get on the bandwagon with the rest of the world or wind up a has-been country crying in our beer about how we got there.

TOM KEMPKE
NORTHFIELD, MN

Were I your employer, I would immediately give you one month's leave with pay and instruct you to spend that time studying all aspects of the metric system. At the end of that month, if you were still of the same opinion, I'd offer you the choice of resigning or of being fired.

DR. JAMES T. BLODGETT
STERLING, MA

I'll take that deal. —Ed.



Reader Project Of The Month

I had been searching for a sofa to match antique, Mission-style furniture that originally belonged to my grandparents. I noticed a design similar to this in a Stickley catalog from the 1930s and thought it matched perfectly. I was unable to find any plans or even replicas of it, until a fellow woodworker alerted me to your January '95 issue. My only deviation from your plans was the use of 1/4-in. white oak plywood instead of solid oak, and a covered plywood platform to support the seat cushion.

BRIAN LAPAGLIA
POMPTON PLAINS, NJ



The only tru Magnum Power

Now it seems that Dodge Ram isn't just part of the most powerful overall line of pickups on the planet. According to a J.D. Power and Associates survey of owners,* it's also the most appealing pickup in America.

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ck with both and J.D. Power.

Chevrolets is pretty appealing too."

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And to keep building cars and trucks that change them. Want more information? Call 1-800-4-A-DODGE.

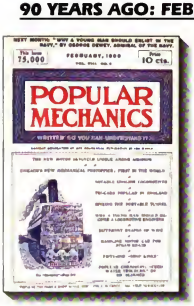
*1995 Automotive Performance, Execution, and Layout Study, based on 27,859 responses. **We calculated resale using avg. trade-in values for full-size '94 models vs. MSRPs, published in '95 Jan.-Sept. *N.A.D.A. Official Used Car Guide*® monthly editions.

America's Truck Stop

The New Dodge
A DIVISION OF THE CHRYSLER CORPORATION

TIME MACHINE

90 YEARS AGO: FEBRUARY 1906

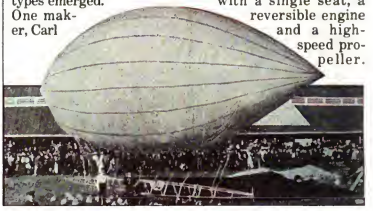


Power Liner

The steam turbine was rapidly displacing the reciprocating engine as the powerplant of choice for big ships. And the largest turbine-driven steamship, the *Carmania*, was in service on the Cunard Line. The liner's trials attracted scores of engineers, drawn to the machinery room, where three turbines cranked out 21,000 hp. The absence of vibration was a big selling point, and turbine power would soon enable ships to take on enormous dimensions.

Blimp Lite

Even well after the turn of the century, dirigibles continued to enthrall engineers. A ballooning diversity of types emerged. One maker, Carl Myers of Frankfort, New York, built what he claimed was the first portable airship. The 54-ft. gas bag carried a light, boatlike frame with a single seat, a reversible engine and a high-speed propeller.



60 YEARS AGO: FEBRUARY 1936

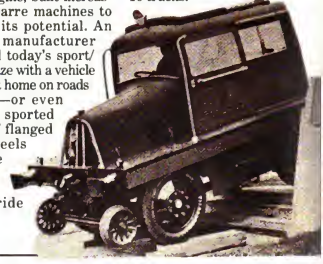


Fighting Words

Inspired by the ugly conflict in Ethiopia, Hiram P. Maxim, son of the machine-gun inventor, wrote a chilling prophecy of the next European war. Tanks would dominate the battlefield, he predicted, adding that nations would unleash poison gas, incendiary bombs and even ultrahigh-frequency sound waves on each other. Cities would be the targets of surprise attacks, he wrote, and "chaos such as civilization has never beheld will reign supreme."

Stair Climber

Automotive engineers, who couldn't get enough of the diesel engine, built increasingly bizarre machines to harness its potential. An English manufacturer presaged today's sport/utility craze with a vehicle equally at home on roads or rails—or even steps. It sported a pair of flanged steel wheels that were dropped into position to ride railroad tracks. The diesel engine itself put out enough power to haul as many as 10 trucks.



30 YEARS AGO: FEBRUARY 1966



Screen Gem

Even in the mid-1960s, flat-screen television was the Holy Grail of the video world. One engineer made the most of cathode-ray tube technology, pressing the tube into a flat, 2-sided display. Electron beams peppered back-to-back screens on both sides of the tube. Although you could watch the TV from either side, one of the images would be reversed. We predicted that large-scale versions would soon be embedded in household walls.

Missing Glow

Once the stuff of quack cures and luminous watch dials, abandoned radium was turning up in old barns, forgotten laboratories—even bank vaults. The Public Health Service launched an all-out search for this misplaced radioactivity. PM



Free Highway Safety Kit!

$34.95 value!

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(Which is why Solo 5 now comes with a highway safety kit—including jumper cables—absolutely free!)

At Escort, we design products that work intelligently. Solo 5's AutoShut-off is just one of the smart features designed into this five-band cordless detector. And, for a limited time, you get more than the convenience of battery-powered Solo 5; you also get—absolutely free—a six-piece road kit designed to keep you on the go. With Escort, you're prepared for any eventuality, whether it's a radar or laser threat or a highway breakdown.

Solo 5 features:

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- SafetyPilot™ detects safety signals which warn of approaching road hazards, moving emergency vehicles and railroad crossings (in cities using the Safety Alert™ system).
- Different audible tones identify the specific type of radar, laser or safety signal detected.
- Anti-falsing circuitry minimizes "false" radar or laser signal alerts.

Escort Highway Safety Kit

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(free with the purchase of a Solo 5).
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Any detector which picks up K-band radar will also detect "safety radar." The problem: if you get a K-band radar alert, how do you know you're being monitored for speed or if a potential road hazard (emergency vehicle, railroad crossing, accident site, highway construction) is nearby? With an Escort SafetyPilot detector, you'll know instantly because SafetyPilot can distinguish between standard K-band radar and safety signals. You'll get a different visual and audible alert for each.

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Popular Mechanics
FEBRUARY 1996

TECH UPDATE

News Of Tomorrow's Technology Today



Search-And-Rescue Apparatus Goes To The Dogs

BRIGHTON, ENGLAND—Under normal circumstances, seeing the grizzled face of a police dog just inches from your nose doesn't flood your heart with relief. But no sight is more encouraging if you're trapped beneath the rubble of a collapsed building. It's especially welcome when the dog is wearing a miniature infrared camera that lets emergency workers know you're still alive. A microphone and loudspeaker stitched into the dog's collar allow you to communicate with your rescuers.

The system is known as WOLVES, short for Wireless Operationally Linked Electronic and Video Exploration System. England's emergency-service police units will soon harness this technology, which was conceived by a detective constable.

Although camera-laden robots are sometimes now dispatched into disaster sites, dogs remain the rescuers of choice for most emergency-services units. Not only are dogs intuitively familiar co-workers, they're still more sure-footed and quick-witted than today's preprogrammed robots.

What's more, when engineers began testing the WOLVES apparatus last year, they found that the head-mounted infrared camera returned much steadier images than anticipated. It turns out that even when a dog is weaving through debris, its head remains relatively immobile, acting like a gyrostabilized platform.

Police dog carries miniature infrared camera into disaster area, returning images of survivors via radio link.

The dogs, by the way, aren't fazed by their high-tech trappings. They adjust to carrying the WOLVES equipment in only half an hour.

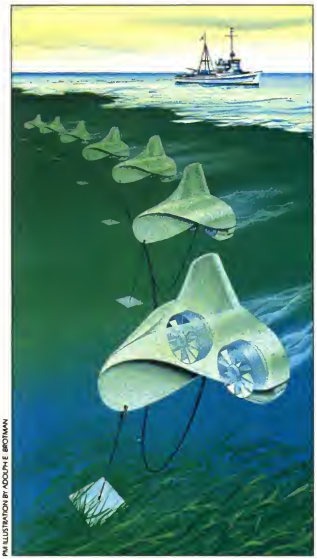
Editor/Writer: Gregory T. Pope
Reporters: John Boatman, Philip Chien, Mike Fillon, William Garvey, Scott Gourley, Barry Rosenberg, Fenella Saunders, Bob Scheier

Highlights This Month

- **Electric Current**—Power from the Gulf Stream.
- **Fire And Forget**—Artillery rounds get smart.
- **Missile Alert**—Sidewinder's follow-on.
- **Chip Shots**—Microprocessor camera fights crime.
- **Heavyweight Flight**—Drones to hoist 5 tons.
- **Charge It**—Electric cars become affordable.
- **Thar She Blows**—Satellite to track whales.

(More Tech Update on page 18)

Tapping Into The Gulf Stream



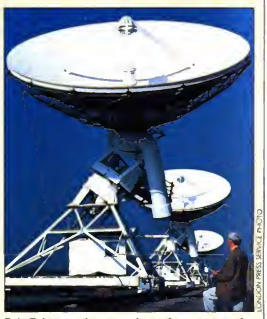
PW ILLUSTRATION BY ADOLPHE BROWN

Hydrofoil-like water turbines could reap energy from 3-knot Gulf Stream current off the Florida coastline.

FORT PIERCE, FL—For more than 20 years, engineers have viewed the warm waters of the Gulf Stream off the east coast of the United States as a potential gold mine of renewable energy. Water turbines could tap the current in much the same way that wind turbines convert moving air into electric power.

Now researchers believe the technology has matured enough to support an undersea turbine farm. The generators would be based on high-efficiency submarine propellers developed at Harbor Branch Oceanographic Institution. They would work inside hydrodynamic fairings anchored to the seafloor.

One likely location for a turbine farm: the Navy's South Florida Testing Facility, an offshore zone situated where the Gulf Stream runs closest to the coast.



LOCKHEED MISSILES & SPACE PHOTO

Ryle Telescope is centerpiece of astronomers' efforts to solve mystery of galaxy formation.

Cosmic Detective

CAMBRIDGE, ENGLAND—Back in 1989, when NASA's COBE (Cosmic Background Explorer) satellite mapped the cosmic microwave radiation left over from the creation of the universe, scientists thought they would soon have the cosmos figured out. No such luck. It turns out that the COBE findings gave them more questions than answers, particularly about how the galaxies were formed.

Now attacking the problem is the recently upgraded Ryle Aperture Synthesis Telescope. The rail-mounted multidish radiotelescope is remapping the microwave radiation, seeking to reveal faint variations that hint at the birth of galaxies.

Green Man From MARSS

HUNTSVILLE, AL—The self-propelled howitzer has stalled, but the stranded gunner isn't peering under the hood, exposed to enemy sniper fire. Instead, he's safe in a nearby foxhole, diagnosing the engine problem through a wireless connection.

That's the vision behind the Maintenance And Repair Support System, or MARSS, developed by McDonnell Douglas. Stitched into a 3-pound vest is a voice-activated computer. On the soldier's head is a small color display. Leadless probes read data from a diagnostic box in the vehicle, so when the soldier has diagnosed the problem and radios for spare parts, he knows exactly what to ask for.



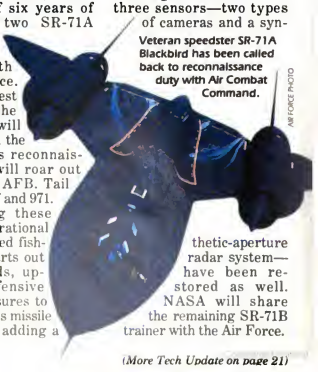
SCOTT GOUDEY PHOTO

Body-worn computer and wireless probes allow soldiers to diagnose vehicle problems from a safe location.

Blackbird Is Back

EDWARDS AFB, CA—Shaking off six years of mothballs, two SR-71A Blackbirds are back in service with the Air Force. Still the fastest airplanes the Pentagon will tell us about, the Mach 3-plus reconnaissance jets will roar out of Edwards AFB. Tail numbers: 967 and 971.

Returning these birds to operational status involved fishing spare parts out of junkyards, upgrading defensive countermeasures to handle today's missile threats and adding a new digital datalink. All three sensors—two types of cameras and a synthetic-aperture radar system—have been restored as well. NASA will share the remaining SR-71B trainer with the Air Force.



AIR FORCE PHOTO

Veteran speedster SR-71A Blackbird has been called back to reconnaissance duty with Air Combat Command.

(More Tech Update on page 21)

Five Businesses You Can Start Yourself!

NRI training in your choice of five in-demand fields gives you everything you need to get started fast

Everybody wants to get ahead, but most people don't know where to start. Now, NRI not only shows you five opportunities for good money, advancement, even a business of your own, but goes on to give you the skills you need to succeed.

Here are five fields (two here and three on the other side) still wide open for the NRI-trained specialist. All five feature low start-up costs and low risk for you. Tailor the size of your business to whatever you can comfortably handle: part-time, full-time, even add employees as your business takes off. Only NRI hands-on training can give you the hands-on skills you need to take advantage of five golden opportunities!



No experience needed

NRI starts you with the basics, then builds your knowledge and skills a step at a time, all the while adding practical know-how through hands-on training. You even get the tools you'll need in the business. And you learn at home in your spare time, with the full support of your NRI instructor and the entire NRI technical staff.

1. Get started fast in home inspection, today's hottest new career

Demand for home inspectors continues to climb—30% to 50% each year—making home inspection one of today's fastest-growing career fields.

Best of all, while the average inspection takes just a few hours to perform, trained inspectors command from $100 to $300 per home, earning as much as thousands per week!

Now, with NRI's new training, you can cash in on the growing demand for home inspection services and earn good money full-time, part-time, even in a business of your own.

NEW! Powerful 486DX2/66 MHz computer and home inspection software included!

From foundations, floors, and roofs to insulation, ventilation, and radon testing, you master every important phase of the home inspection process. Practical projects give you hands-on experience with the tools you need, including the one piece of equipment no successful home inspector should be without...

Only NRI gives you a powerful 486DX2/66 MHz computer system with Windows 95 and Quicken® financial planning software, all yours to train with and keep for use on the job. Plus, you discover how to use your computer, along with the 3-D Inspection System's Report Writing software we supply, to transform field notes into the kind of professional home inspection reports clients pay top dollar for.

Discover how easy it can be to earn extra cash in your spare time or launch your own full-time home inspection service. Send for your free NRI catalog



2. Gain independence as a locksmith

Earn good money making keys, even more repairing and replacing locks, top dollar installing new home security systems. NRI trains you to do all that and more in one complete course.

Income while you learn

NRI's Master Locksmithing course includes a professional Ilco 027A Key Machine and all the tools you need to start earning profits of up to 800% — even as you learn! New expanded training includes automotive lock servicing and electronic security, making the opportunities for an NRI-trained locksmith even greater. You learn every trade secret for servicing and repairing residential, commercial, and automotive locks, even locks on car ignitions equipped with air bags. Plus, your training covers safes and vaults. NRI training includes equipment you train with and keep for future use on the job!

If your needs are more specific, you can choose NRI's Basic Locksmithing, an abbreviated version of the Master course... Automotive Locksmithing, which focuses on this high-opportunity specialty... or Home Security Servicing, providing in-depth coverage of the electrical and electronics principles necessary to make it big in this in-demand field.

Take the first step by sending for your free NRI catalog now!

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Three more businesses you can start yourself, once you train for success the NRI way!

Any one of these five opportunity fields (three here plus two on the other side) could be your chance to be your own boss.

Whichever course you choose, you'll get everything you need to get started fast—the skills and the know-how to do the job right, plus the tools and equipment you need to get your business off the ground. Only NRI makes starting a business of your own so easy!



3. Make Good Money in Building Construction

Get the know-how you need to become a foreman, supervisor, or contractor in a business of your own with NRI's Building Construction course. Over 18 million families will be buying new homes in the next 10 years, while even more will pay for major remodeling and renovation work. That means big profits waiting for you!

Over 100 hands-on training projects

NRI's easy-to-digest lessons and practical projects teach you the skills and professional secrets of carpentry, masonry, roofing, even wiring and plumbing.

You actually frame a house in miniature and construct a framing section in full scale. You'll end up with the know-how to deal with all the building trades, the skill to handle part or all of the job yourself. You'll be ready to start your own building and construction business, get going in the lucrative building industry, or simply move up to the home of your dreams—and save 10% to 50% by building it yourself! Check into building construction as your opportunity field.



4. Learn Air Conditioning, Heating, and Refrigeration

Today, few homes or commercial buildings go up without central air conditioning. Millions of window units in older homes require maintenance and repair. Heat pumps have become so popular, they're now as common as furnaces. And commercial refrigeration calls for skilled technicians to install and service walk-in coolers and freezers, ice makers, and food cases. It all adds up to tremendous opportunity for the trained air conditioning, heating, and refrigeration technician.

Training includes professional tools

NRI trains you to land a good-paying job, pick up extra income in your spare time, even start a business of your own. You're ready to jump right in because NRI includes the tools you need... system analyzer, electronic halogen gas leak detector, tubing and joint tools, even a top-quality vacuum pump for purging systems.



5. New Opportunities Abound in Automotive Servicing

You'll have no trouble getting your ASE certification once you take the course that Richard Petty, America's #1 stock car racer, calls the best of its kind.

To troubleshoot today's computer-controlled automotive systems, you get equipment like a digital multimeter and the new OTC Monitor 4000 Electronic Diagnostic Tester with a redesigned keypad, complete OBD II compatibility, freeze frame option, data stream values, system function indicators, and more!

Plus, you train with and keep professional tools from Pentron—an inductive timing light, vacuum gauge, compression tester, and remote starter—along with the optional Autocraft Ignition Analyzer Oscilloscope, essential for tune-up and diagnostic work on older cars.

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The Army's Artful Artillery

ABERDEEN, MD—While long-range artillery remains the Army's long-term concern (see Tech Update, page 21, Nov. '95), gunnery experts also want to sharpen the accuracy of today's 155mm rounds. That's the aim of the new Low-Cost Competent Munitions program.

The effort focuses on fuses that can be retrofitted to the Army's existing stockpile of 7.5-million rounds. Each fuse will contain a Global Positioning System (GPS) receiver, which picks up position information from satellites, and a microprocessor that predicts the round's trajectory while in flight. A gunner will program the target location into the fuse before he fires the round.

One type of fuse will feature small airbrakes. The round will be aimed at a point beyond its target, and the fuse will use the brakes to decrease its range and home in on the target. Another type of fuse will deploy miniature canards in flight to steer the round to its destination.

Army experiments have already shown that a round in flight can lock on to GPS satellites.



PAI ILLUSTRATION BY PAUL DRAANE

GPS satellites will send position data to artillery rounds so they can adjust their trajectories in midflight.

Smart Supersonic Wing

EDWARDS, CA—Previewing critical technology for a next-generation supersonic airliner, an F-16XL has been flying with a drag-reduction panel on its left wing at NASA's Dryden Flight Research Center.

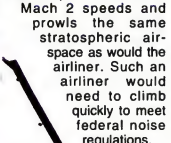
Called a laminar-flow suction glove, the panel consists of a sleeve of titanium riddled with millions of tiny laser-drilled holes. As the plane roars through the sky, a suction fan draws turbulent air through the holes. The effect is to leave a smooth, or laminar, airflow across the wing, reducing drag and boosting fuel efficiency.

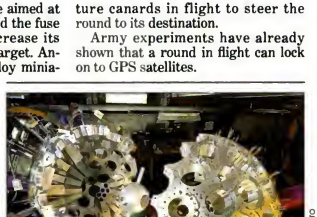
Although such gloves have flown before, the current set of experiments is by far the most thorough—and most pertinent to the supersonic-airliner effort. The F-16XL has the same cranked-arrow wing shape as the proposed High-Speed Civil Transport (see Tech Update, page 22, Feb. '94). It also flies at Mach 2 speeds and prowls the same stratospheric airspace as would the airliner. Such an airliner would need to climb quickly to meet federal noise regulations.



NASA's F-16XL demonstrates laminar-flow suction glove (dark area, forward center on left wing).

NASA PHOTO





LAWRENCE BERKELEY LABORATORY PHOTO

Gammasphere, the world's best gamma-ray detector, will solve riddles of atomic-nucleus behavior.

Catching Some Rays

BERKELEY, CA—The king of all gamma-ray detectors will soon be holding court at Lawrence Berkeley Laboratory. Called Gammasphere, the machine is 100 times more sensitive than any device now in operation.

Gammasphere's precision stems from its 3-pound cryogenic germanium crystals, lodged in two aluminum hemispheres. The crystals trigger currents when hit by gamma rays, which radiate from excited atomic nuclei.

Researchers are eager to test Gammasphere on the latest oddities of the atom-smashing world: superdeformed nuclei. These football-shaped atomic hybrids spit out gamma rays that appear to defy the laws of physics.

(More Tech Update on page 22)

Dogfighter's Best Friend



British ASRAAM may join AIM-9X competition for a new dogfighting missile.

BRITISH AEROSPACE PHOTO

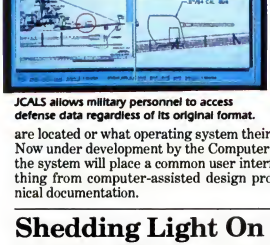
CHINA LAKE, CA—There's a new missile gap, warns the Pentagon, and America is lagging. Now on the world market are Russian and Israeli short-range air-to-air missiles that can outturn anything in the sky, defeating the maneuverability of our front-line fighters. The missiles can hit targets at which the aircraft that launches them isn't pointing—a capability our AIM-9M Sidewinder lacks.

To catch up, the Air Force and Navy are funding the AIM-9X, with Hughes and Raytheon competing to develop the missile (see Tech Update, page 26, Oct. '94). But British Aerospace may already have something to meet the Pentagon's requirements. Called the Advanced Short-Range Air-to-Air Missile, or ASRAAM, the weapon relies on a highly accurate infrared seeker and an agile airframe to hit offbore-sight targets—even targets approaching from the rear.

Any plane that can carry a Sidewinder can carry an ASRAAM. The weapon is now undergoing live-fire tests at the Naval Air Warfare Center.

Desktops Of Defense

MOORESTOWN, NJ—If you think the computer network at your office is a nightmare, imagine working for the Pentagon. Across the country, military bases and contractors run systems with different formats, considered "islands of automation" linked by "rivers of paper."



COMPUTER SCIENCES CORP. PHOTO

JCALS allows military personnel to access defense data regardless of its original format.

But all of that will change with the advent of JCALS, the Joint Continuous Acquisition and Lifecycle Support initiative. The goal of JCALS is to create a data environment that authorized users can access regardless of where they are located or what operating system their computer uses. Now under development by the Computer Sciences Corp., the system will place a common user interface over everything from computer-assisted design programs to technical documentation.

Invisible Art Alarm

GREENBELT, MD—The next time you consider stealing the *Mona Lisa* from the Louvre, think again. The painting just might be protected by an undetectable alarm system featuring sensors developed at NASA's Goddard Space Flight Center.



TVI ILLUSTRATION BY KURT HUYNH

Flat-panel arrays of capacitflectors line wall behind painting to be guarded.

Known as capacitflectors, the devices work on the principle that capacitors store electric fields between two plates. In a capacitflector, one plate is the sensor, while the other is the target to be sensed. Charged with a voltage, the sensor both puts out a field and then picks up any changes in that field, such as those that result from the target's movement. An energy-reflecting shield sits behind the sensor to keep its "vision" focused ahead.

Shedding Light On Chemicals

SHEFFIELD, ENGLAND—Occupational-safety experts in Britain have concocted a new way to detect chemical skin contamination in the workplace. The key is a dye added to the chemical in question. When exposed to ultraviolet light, the dye fluoresces brightly, showing where the chemical has splashed on exposed skin.

Engineers have packaged ultraviolet lamps into a walk-through station called the Fluorescence Monitor. Workers in facilities where toxic chemicals are used would simply walk through the station when they leave work. Possible settings for the device range from factories to farms.



TVI PHOTO BY THOMAS HOPKINS

Fluorescence Monitor triggers glow of dye added to chemical that's landed on exposed skin.

Micro-Cam Security

HEMPSTEAD, ENGLAND—A miniature infrared camera built into a computer chip has given law-enforcement officials a potent new security weapon in the war against crime.

Created by TVX International, the wide-angle camera snaps digital images and sends them instantly, via phone lines, to a monitoring station. The device's tiny size means it can elude the eyes of robbers, who typically shoot out video-surveillance cameras or demand the videotape of their crimes. The system, which can be hooked into existing security networks, is already at work at several locations in Los Angeles.



Miniature infrared wide-angle camera shoots and transmits digital images of crime in progress.

(More Tech Update on page 24)

WE WON FOUR EVENTS. YOU GET TO PARK THE TROPHY IN YOUR DRIVEWAY.



Power. Payload. Towing. And Braking.* The Tacoma 4x2 went up against leading competitors and brought home first-place finishes by the truckload. But what else would you expect from a Toyota Truck? The Tacoma boasts an available 190-horsepower V6. And the highest standard towing and payload in its class.** You also get the solid peace of mind that comes with owning a Toyota. So why just wash an ordinary truck in your driveway, when you could be out there polishing a trophy?

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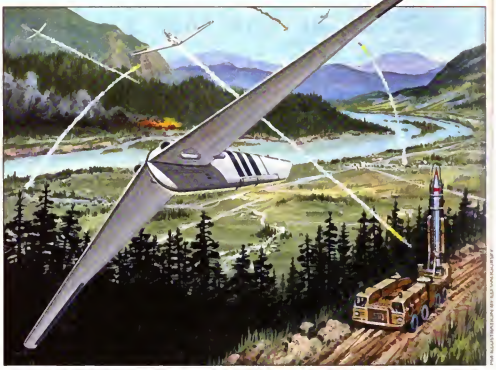
Heavy-Lift Drones To Fly And Fight

WASHINGTON, DC—Unmanned aerial vehicles, or UAVs, have already winged their way into the military picture as reconnaissance aircraft. It's inevitable that they will one day carry weapons, as well.

Looking ahead to that day, Boeing, Loral and Frontier Systems have teamed to blueprint a huge drone strong enough to lift a 5-ton payload. Called the W570, the design features a 160-ft. wingspan, dwarfing even the Tier II-plus spy drone (see Tech Update, page 20, Oct. '95). Engines buried in the wing structure would propel the unmanned vehicle to 300-miles-per-hour speeds.

The W570 could loiter at altitudes up to 80,000 ft. for 60 hours at a stretch, acting as a surrogate communications satellite or as a lookout for ballistic-missile attacks.

In a target-strike role, the drone would carry air-to-ground or air-to-air missiles in a munitions pod. This component would drop down from the vehicle's belly and retract after firing, much like the system aboard the F-117 stealth fighter.



W570 heavy-lift drone could seek out and destroy enemy missile launchers.



The CityBee might give Californians an electric car without the sticker-price shock.

Invasion Of The CityBees

BURBANK, CA—With stringent air-purity laws only two years away, Californians are facing a dilemma. While they're willing to buy cars that run on an electric charge, they don't want to be charged extra for them.

One car that won't sting buyers: the CityBee, a 2-seater that will sell for $10,000. Developed by a Norwegian consortium, the vehicle travels 60 to 80 miles per charge. The 9-ft.-long car weighs only 1650 pounds, thanks to an aluminum space frame and a plastic body, and meets U.S. safety standards.

This year, 40 CityBees will swarm in a demonstration with San Francisco's Bay Area Rapid Transit system, shuttling commuters from homes to stations. Plans are to manufacture the vehicles in California.

Real Decoder Ring

DALLAS, TX—Now you don't have to send in box tops to get a decoder ring. Dallas Semiconductor and Jostens Inc. have developed one that does more than spell out ads for Saturday-morning television cartoons.

The ring houses a memory chip that contains an encryption key to decode computer-data files without having to enter a lengthy password. You simply press the ring against a touch-memory probe mounted on the computer. A transceiver sends data through the ring. Applications include stockroom inventory and electronic commerce.



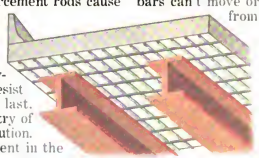
Decoder ring sends data to computer via touch-memory system.

Bridge To The Future

OTTAWA, ONTARIO—Steel reinforcement rods cause millions of dollars worth of damage to aging bridges every year. When water seeps into reinforced concrete, the steel rusts and swells, cracking the structure. Reinforcing rods in newer bridges are coated with epoxy to resist rust, but the epoxy doesn't always last. Now, engineers at the Ontario Ministry of Transportation have come across a solution.

Instead of embedding reinforcement in the concrete, they are bolting the steel to the underside of the span. Tests show that as long as the reinforcement bars can't move or twist, the bridge deck can be cast from simple concrete.

Bridges erected in this way would cost as much as conventional spans, but would last longer and be far cheaper to maintain when they begin to rust. This spring, engineers will build a full-scale demonstration bridge.



Steel reinforcement bars bolt under bridge's concrete deck, allowing for easy maintenance when rust sets in.

PM ILLUSTRATION BY KURT NOVAK

(More Tech Update on page 26)



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Thar She Blows, Via Satellite

YOKOHAMA, JAPAN—The International Whaling Committee has asked Japan to monitor the blue whales in the Antarctic Ocean. Sensitive to Japan's poor reputation when it comes to whaling, Japanese researchers have come up with a novel way to do this—a method that won't involve killing Earth's biggest animals.

The proposal teams sensor-laden harpoons with a small satellite. Each dartlike harpoon, too small to harm the whale, will carry a sealed capsule with a GPS receiver, environmental sensors and a UHF transmitter. The whale's swimming motion would generate power for the instruments, using a mechanical system developed for Seiko watches.

The 50-pound satellite, in a polar orbit, would receive signals from any tagged whales under its flight path. A water-pressure sensor would alert the capsule to transmit data whenever the whale surfaces.

The idea is to tag 50 to 100 whales and monitor them for three years. Environmental groups will be watching closely to make sure whale hunters don't abuse the system.



PM ILLUSTRATION BY JOHN C. DERU

Electronic capsule will send data on whale's location and nearby environmental conditions to orbiting satellite.



JOINT PUBLICATIONS PHOTO

Trimaran warship would offer better seakeeping and provide more deck space than conventional equivalent.

Three Hulls For One Warship

PORTSMOUTH, ENGLAND—As if inspired by Kevin Costner's trimaran in "Waterworld," the British Navy is considering a triple-hulled frigate.

Although the trimaran ranks as one of the world's oldest ship designs, its use is reserved mainly for sailboats. But a trimaran warship would boast many advantages.

For one thing, its hydrodynamic resistance would be lower than that of a conventionally hulled vessel. And a trimaran could maintain higher continuous speeds in rough seas because of its lower center of gravity. The sleek design would shrink its radar signature. And the cross-deck structure would create room for a helicopter flight deck, positioned where the ship pitches least. This would extend flight operations in stormy seas.

Vosper Thornycraft has already designed a trimaran corvette, a 1500-ton 328-ft.-long convoy-escort vessel. If the United Kingdom issues a trimaran-frigate contract, the ship would begin sea trials in 1999.

Tank Looks To Tomorrow

WARREN, MI—Tank crew compartments may wind up resembling airliner cockpits if research being conducted at the Army's Tank-Automotive Command pays off.

Vehicle-electronics engineers have sketched out a compartment in which two crew members sit side by side before wraparound high-resolution panoramic displays. The crew members would hold similar rank and share driving, weapons and communications duties. They would interact with multifunction displays for tasks ranging from monitoring fuel levels to acquiring and attacking targets.

Not surprisingly, the research initiative, known as Crewman's Associate, derives from a 1980s chopper-cockpit technology push called Pilot's Associate.



Tank of the future features panoramic displays and aircraft-type controls.

PM ILLUSTRATION BY ADOLPH E. BROTMAN

(More Tech Update on page 28)

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V8's Challenge To The Turboprop

FORT SCOTT, KS—New planes are hardly novelties in Kansas, but the Star*Kraft 700 has even the old hands at Beech and Cessna talking. The brainchild of local businessman/pilot Roger Kraft, the plane is an all-composite, pressurized 8-place executive aircraft with twin engines set in a push-pull centerline-thrust configuration.

Now undergoing flight tests with a pair of 350-hp liquid-cooled Continental TCM-550A engines, the Star*Kraft is expected to deliver a 275-knot cruising speed and a range of 1500 miles—numbers you'd normally associate with a turboprop.



HAWKER SIDDELEY CANADA PHOTO STAMENKO PHOTO

Star*Kraft 700 will soon fly with a pair of Orenda V8s, which deliver turboprop-like performance.

Those figures should only go up when the twin 600-hp Orenda V8s are installed. Developed concurrently with the Star*Kraft, this powerplant derives from a Can-Am McLaren-Chevrolet racing engine. Hawker Siddeley Canada is aiming for certification of the engine this year. Its main attraction is price: $100,000 versus $250,000 for the turboprop engine whose performance it emulates. Total projected selling price of the Star*Kraft 700: $1.6 million.

Mortar Attack With Precision

PICCATINNY ARSENAL, NJ—Given the Pentagon's fondness for "smart" weapons, it's not surprising that brains are coming to even the lowly mortar. The Army is lobbing $10 million at Lockheed Martin to develop the 120mm Precision Guided Mortar Munition, or PGMM. It would be used against tanks cloaked in reactive armor, concrete bunkers and any target requiring pinpoint attack.

Conventional mortars, which shoot from a tube and travel in an elliptical trajectory, can land far from their targets. But the PGMM will sport four stabilizing tail fins and four fold-out wings that will create a controlled glide path to the target. In a "fire and forget" mode, a nose-mounted infrared seeker will keep the target locked in. The requirement is to nail targets that are at least 5 miles away.



LOCKHEED MARTIN PHOTO

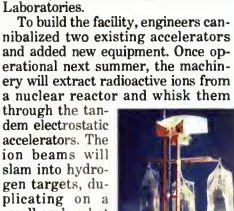
Smart mortar uses fins and wings to create a controlled glide path to its target.

PGMM borrows heavily from Germany's Diehl GmbH Bussard mortar. Indeed, the Europeans are well ahead of us in smart-mortar development and were initially the only candidates in the PGMM competition.

Atom-Smasher Of The Bizarre

OAK RIDGE, TN—Physicists love creating exotic types of matter that do not occur naturally. They will soon have a new tool with which to do this: the Holifield Radioactive Ion Beam Facility at Oak Ridge National Laboratories.

To build the facility, engineers cannibalized two existing accelerators and added new equipment. Once operational next summer, the machinery will extract radioactive ions from a nuclear reactor and whisk them through the tandem electrostatic accelerators. The ion beams will slam into hydrogen targets, duplicating on a small scale what happens when a star explodes. Researchers predict they will be able to create between 150 and 200 new "nuclear species."



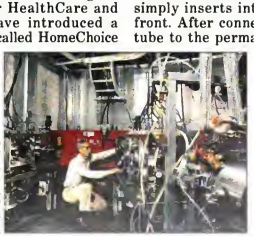


Holifield facility at Oak Ridge will be the heavyweight champion of radioactive-particle accelerators.

Portable Dialysis While You Sleep

MCGAW PARK, IL—Bulky dialysis machines, which remove impurities from the bloodstream of kidney-failure patients, may soon be things of the past. Baxter HealthCare and DEKA Corp. have introduced a portable system called HomeChoice that weighs only 25 pounds.

The machine features a fluid-management system driven by 10 miniature, solenoid-actuated pneumatic valves. Inside, dialysis fluids circulate through a mazelike cassette that the patient simply inserts into the machine's front. After connecting a cassette tube to the permanent, surgically implanted peritoneal catheter in the patient's abdomen, the user presses the GO button. A microprocessor controls the entire procedure, allowing the machine to go through its paces while the patient sleeps.



BAXTER HEALTHCARE PHOTO

Using compact fluid-movement cassette, portable HomeChoice machine, in foreground, replaces large dialysis systems.

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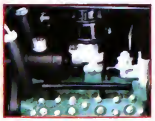
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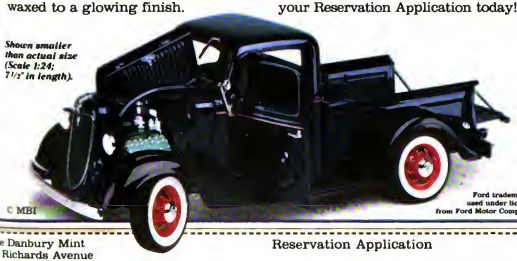
The deluxe interior features authentic seats and miniature dashboard dials and gauges.



The tailgate, held by two support chains, swings down freely. Note the authentic ribbed truck bed.



The miniature engine is a precise replica of the original 221 cubic inch, 85-hp V-8.



Shown smaller than actual size (Scale 1:24; 7½" in length).

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Detroit Spy Report

BY JIM DUNNE, Detroit Editor



Hot-Blooded Camaro

● Beneath this Camaro's skin beats the heart of a Corvette—a 1998 Corvette to be precise. Chevy engineers are using Camaros as test mules for the new 'Vette powertrain, which consists of a 340-hp 350-cu.-in. aluminum V8 and a 6-speed manual transaxle. The gearbox is mounted at the rear axle for better weight distribution and balanced handling.

The photos reveal this "Cormaro's" identity. The obvious rear-fender flares accommodate the 'Vette's wide tires. Other tip-offs are the hood bulge, the central exhaust pipes and the modular-look wheels. By using a Camaro tester, engineers can evaluate the Corvette's drivetrain on public roads without revealing the new car's styling. Besides, it's less of an engineering headache to adapt the Camaro's unibody for the powertrain than it would be to convert a frame-and-body Corvette.



The Next Windstar

Chrysler keeps cranking out its winning new minivans, and everyone else is feeling the pinch. While GM is readying replacements for its plastic-bodied front-drive minivan family, Ford is working on the next Windstar. The big question for Ford is whether it's worth reengineering the Windstar's unibody to accommodate a sliding door on the driver's side. That second sliding door has proven to be a big success for Chrysler's minivans.



This spied Windstar prototype doesn't show a sliding door on the driver's side.

Chrysler Concepts

If you get to an early-winter car show, take a close look at Chrysler's concept cars. The Intrepid ESX and Chrysler LXH 4-door sedans are strong indicators of what Chrysler plans for the future. Insiders at the No. 3 carmaker say the overall design of the company's 1999 LH cars will closely follow the exterior shape of those concept cars. That means lower rooflines, an even faster angle to the windshield, a massive instrument panel and a central location atop the panel for many gauges. "The instrument panel is so large," explains one Chrysler designer, "that we can put the gauges up there where they can be easily read and at the same time relieve some crowding from in front of the driver."

The unusually long wheelbase of the Chrysler LXH (124 in.) is almost a foot longer than today's LHS. Its overall length is also stretched to 224 in., compared to the LHS's 207 in. Take those numbers seriously—Chrysler appears set on building a larger flagship sedan to compete with large Lincolns and Cadillacs.

1997 Oldsmobile Cutlass

Our photo isn't needle-sharp, but it's clear enough to discern that this test car is the '97 Olds Cutlass, a replacement for the Achieva (and not to be confused with the new Cutlass Supreme to be introduced in 1998). This Cutlass is a twin of the '97 Chevy Malibu and will be offered only as a 4-door. Also, it's a compact, and it's similar to current GM small sedans in that it has front-wheel drive, a 4-cylinder engine and a choice of a 4-speed automatic or 5-speed manual transmission. PM



Sister to the '97 Chevy Malibu, this is an Olds Cutlass sedan.



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Ultimate Shooter's Team Challenge

BY TODD WOODARD



● From the earliest pioneer days, Americans have enjoyed getting together on festive occasions to test their all-around marksmanship skills. Today, that tradition is still alive. In late March, hundreds of gun aficionados will gather in Sunrise, Florida, to vie for the right to be called the country's best all-around team of shooters. The event is the Chevy Truck Sportsman's Team Challenge (STC) National Championship, and there's nothing quite like it in shooting sports.

What makes the STC format unique is that it arguably produces the equivalent of a modern-day Annie Oakley or Buffalo Bill Cody, because, unlike other shooting competitions, it is a test of rifle, pistol and shotgun marksmanship. What makes the National Championship such a draw for shooters is the $150,000 in cash and prizes. This year's event is slated for March 28 to 30 at the Markham Park Regional Target Range.

The STC doesn't require shooters to mow down similar targets in a few seconds, nor does it require them to hit the same X ring with every shot. Instead, it calls upon shooters to hit targets at a fast pace and to adapt to a varied program of target courses and guns. In addition, it rewards teamwork and gun-handling skills as much as accurate shooting. Here's how the format works on both the national and regional levels.

An STC match is structured with three shotgun events (the Flush, Flurry and Mixed Bag) and three rifle and pistol events. Each of the six events is worth a possible 100 points, for a maximum total of 600.

In the Flush shotgun event, the three team members stand side by side in shooting booths. At the call of "Pull," five clay targets are launched simultaneously in crossing and outgoing directions. Two team members fire two shots, and the third takes a single shot even if a target isn't broken. Then, 45 single clay birds are launched at a rate of one per second.

By making one team member take only a single shot during the initial flight, a good team can make sure that no birds fly by unfired upon while everyone is busy reloading empty guns. Champion teams plan it out so that one member is always shooting while the others are rapidly reloading.

The Flurry event employs the same release sequence, except that the birds come toward and above the shooters.

During the Mixed Bag event, teamwork takes on a different role. Here, shotgunners shoot at paired targets that enter the target zone from nine directions. Since it's nearly impossible to locate and shoot some combinations without help, teammates who aren't shooting cry out, "Incomer," "Rabbit," "Overhead" or some other helpful indicator. In this event, one shooter takes nine pairs and the other two team members shoot eight pairs apiece for a total of 50 birds.

In the three remaining events, Rifle, Combo and Handgun, team members fire at metal knockdown plates.

The Rifle event is structured so that three standing shooters use scoped .22-cal. rifles to knock down 46 targets at distances ranging from 45 to 90 yd. Metal faceplates with shapes cut out of the center (diamonds, stars, ovals, circles and squares) cover the actual target plates, which fall when hit cleanly by a round. Striking a faceplate will not result in a target-plate knockdown.

Open Class competitors (many of whom are professional shooters) have 1 minute and 45 seconds to knock down the targets. Sportsman Class shooters get 2 minutes. Any reloading must be done during the course of fire.

The strategy most teams use during the event is to have the strongest rifle shooter start on the highest-



Scopes aid accuracy in the long-range centerfire handgun event.

scoring targets: the orange diamonds and stars located at 90 yd., which count for 5 points apiece. Many world-class shooters have emptied an entire clip trying to thread the needle through the stars only to have the shots graze the irregular inside edges.

The Combo is the crossover stage between the Rifle and Handgun events. In the Combo event, two shooters fire .22 pistols while the third fires a .22 rifle. The goal is to hit 50 discs contained in seven target banks ranging from 25 to 80 yd. away. The discs are 2, 3 and 4 in. in size, and in three of the banks, the 4-in. discs must be hit before the 2-in. discs can be knocked down.

Each shooter begins with a 20-round magazine (or a magazine strategically loaded with fewer rounds). The rifle shooter typically begins on the farthest target bank (at 80 yd.) or the second farthest bank (at 60 yd.) and works inward. Simultaneously, the pistol shooters begin firing at the nearer banks and work their way out. When one of the pistol shooters goes empty, he loads magazines for the other shooters. Once the front banks are down, then everyone moves to the outer banks. The key to the event is to make sure the rifle shooter doesn't run out of ammo.

The Handgun event mixes rimfire and centerfire handguns in a tag-team affair. The shooters begin at a starting box behind the firing line facing three distinct sets of plates. On the right is the precision rimfire course, which is composed of target banks containing 4- and 6-in. discs (24 total) located 20 and 25 yd. away. In the center is the action-centerfire course, which is made up of 12 plates of different sizes and shapes standing on pedestals 7 to 25 yd. distant. On the left is the long-range centerfire course, which is made up of 12 4-in.-sq. plates located 25 and 35 yd. away.

At the start of the event, the first shooter runs from the starting box to a shooting station on the right, inserts a loaded magazine and begins shooting. After he clears the targets, he must lock the action open on the handgun and remove the magazine before running back to the starting box and pressing a timer button to release the next shooter. The next shooter then runs to the center shooting station, clears the targets, empties his handgun and runs back to the starting box to press the timer button. The third shooter finishes the final set of targets, clears his handgun and races back to press the timer.

The Open Class teams are given 1 minute and 35 seconds to complete the Handgun course. While the Sportsman Class teams are given 2 minutes and 30 seconds.

Because the STC event has such a varied format, a major challenge of the competition is to match the best firearms to the appropriate event.

Most shooters for the Rifle and Combo events employ variations of Ruger's 10/22 autoloading rifle, which uses an easy-to-load rotary magazine. The most unusual rifles of this type are called "chin guns." Where the cheekpiece would normally be on a regular stock, a chin gun has only a small platform on which the shooter rests his chin. These rifles also feature skeletonized buttstocks of tubular metal and a heavy match barrel with a muzzle weight and deep aluminum forend.

Top teams at STC events use different firearms for each of the three segments in the Handgun event. A typical choice for the precision-rimfire course is a .22-cal. Smith & Wesson Model 41. For the action-centerfire segment, compensated .45s and .38 Supers are frequently the guns of choice. However, one of the fastest shooters, Jerry Miculek of Princeton, Louisiana, uses a revolver and a cylinder speedloader. On the long-range centerfire course, shooters typically use a .38 Special revolver fitted with an 8-in. barrel and a 4-power telescope. Some teams bring custom firearms created solely for the event by expert gunsmiths.

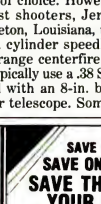
However, veteran STC competitors insist that while technology is important, it can't replace teamwork and gun-handling basics. Before the Handgun finals last year, Doug Koenig of the winning team of Sierra/Starline could be found on the practice range—but he wasn't firing a shot. Over and over, he would pick up his .22 pistol, and in one smooth motion, insert an empty magazine and put the front sight on a distant target. Then he would release the magazine, open the slide and lay the cleared pistol back on the bench.

"The STC really isn't about shooting," explains Koenig. "It's about teamwork and gun-handling skills. A dropped magazine. A clay target no one shoots at. A misfire you can't clear. Those are the hidden challenges of the STC."

For budding Annie Oakleys and Buffalo Bill Codys, there is still time to enter this year's Chevy Truck Sportsman's Team Challenge National Championship. The deadline is February 15. For information about entering the National Championship or a regional STC event, contact the National Shooting Sports Foundation, Dept. PM, 11 Mile Hill Rd., Newtown, CT 06470; (203) 426-1320. PM

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When Bad Things Happen To Good Rockets

BY GREGORY T. POPE, Science/Technology Editor, and PHILIP CHIEN



● January 25, 1995. A Chinese Long March 2E blasts off from the Xichang launch site. Fifty seconds into the flight, failure strikes dramatically. The nose-cone fairing splits. A blast of air tears apart the payload, a Hughes telecommunications satellite. Debris rains across dozens of square miles of Sichuan farmland, reportedly killing several farm workers.

March 28, 1995. A converted ICBM pop-guns from a steam-driven launch canister at Russia's Plesetsk Cosmodrome. Atop the 5-stage START vehicle ride two microsatellites built by Israel and the University of Mexico. But the satellites never make it into orbit. The START's upper stage explodes in midflight.

June 22, 1995. A Lockheed L-1011 widebody airliner takes off from Vandenberg Air Force Base bearing a winged Pegasus XL rocket. This stretch version of the standard Pegasus launch vehicle has failed once before, so engineers are nervous. They have reason to be. Two minutes after separating from the plane, the rocket tumbles out of control.

August 5, 1995. A Delta II roars off Launch Pad 17B at Cape Canaveral, carrying Koreasat 1. But one of its nine strap-on solid-rocket boosters fails to separate, and the launch vehicle must lug the empty motor's dead weight into the sky. The result: Koreasat 1 winds up in a too-low orbit and must expend its own fuel to climb to a geostationary position.

August 15, 1995. From Vandenberg Air Force Base, a Lockheed Martin LLV-1 leaps skyward on its first flight. But toward the end of its first-stage burn, the rocket veers off its flight path, and range safety officers trigger its self-destruct mechanism.

October 23, 1995. The long-delayed Conestoga lifts off from NASA's Wallops Flight Facility, Virginia, carrying the METEOR 1 commercial-experiment payload. As it barrels through maximum dynamic pressure, the launch vehicle begins to disintegrate. Even before safety officers can react, the rocket's on-board destruct system terminates the flight. But the system does not function completely. Still-burning motors and other debris spiral across the sky and pepper the waters off Assateague Island.

Six different launch vehicles, six different failures. Indeed, 1995 was a rocky year for rocketry—and a busy year for failure investigation boards. Last year's string of misfires provides an opportunity to look into these little-publicized brain trusts of the space world: the rocket detectives.

Anyone appointed to an investigation board, which forms whenever a launch vehicle fails, has to be half rocket scientist, half sleuth. The panels are the launch industry's equivalent of the National Transportation Safety Board (NTSB), which probes air crashes.

But rocket-failure boards face even stiffer challenges than air-disaster investigators. When a plane goes down, probers can sift through the wreckage, recover the flight-data recorder and piece together the scenario. When a launch vehicle fails, investigators are usually stuck with nothing more than telemetry—the data radioed from a rocket during launch—and some long-range photography. The hard evidence—wreckage—winds up at the bottom of the ocean. That's because, at least in the United States, launch vehicles must be fired over water.

In addition, rocket-failure investigation boards aren't always willing to make their findings public. When the Long March shattered, Hughes and the China Great Wall Industry Corp. refused to release the results of the investigation. A joint press release blamed "seasonal winter wind shear." Meanwhile, U.S. rocket experts have yet to see the results of Russia's investigation of the START failure.

Rocket detectives fare better when looking into domestic launch failures. Telemetry usually harbors the early clues. In the case of the Pegasus XL failure, telemetry indicated that the second-stage nozzle hadn't been swiveling enough to control the rocket's flight. Board members guessed that the first and second stages were mated incorrectly, and that the interstage—a ring that links the two stages—was hampering the nozzle's full range of motion. After interviews with vehicle-assembly personnel, their suspicions were confirmed.

The Delta II mystery was a little trickier, because the usually reliable launch vehicle carries little instrumentation. But photography revealed a clue: Neither of the two redundant explosive lines, which trigger the separation of a booster, had detonated.

At first that puzzled the rocket detectives, because they deemed it unlikely that both lines could fail independently. To probe further, engineers hooked up an inert booster to a launch simulator and noted that the lines did conk out when exposed to high temperatures. Logic suggested that heat stress had occurred in a spot where the two lines ran closest to each other. Quick to restore the reputation of the Delta II, McDonnell Douglas has added extra thermal protection to that area for future launches.

The investigation report for the LLV-1 failure came in too late to make this issue. But the rocket detectives believe they have already nailed the culprit behind the most recent mishap, the Conestoga/METEOR 1 incident. Once again, telemetry divulged a telltale clue. The rocket's inertial measurement unit appears to have been vibrating, because it was putting out a noisy guidance signal to the on-board flight computer.

From that, investigators deduced the ensuing chain of events. The flight computer interpreted the signal as an indication that the rocket was wiggling, so it commanded the booster nozzles to compensate by swiveling. But this unnecessary motion caused the nozzle-movement system to run out of hydraulic fluid, leaving the nozzles stuck in a 10° yaw position. That pushed the vehicle out of its flight path, and the out-of-kilter attitude put excess stress upon the fairing, which simply fell apart. What happened to the self-destruct mechanism remains under investigation.

Although 1995 saw a rash of failures, the year also included more than 60 successful launches around the world. With the exception of the Delta II failure, it's clear that the mishaps arose from growing pains, as launchers ironed bugs out of new rockets and gained experience the hard way. With hundreds of thousands of parts, any launch vehicle is likely to fail from time to time. That means the rocket detectives will continue their high-tech sleuthing. PM

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Asia Spy Report

BY SCOTT OLDHAM, West Coast Editor



Honda's new CR-V will go head to head with Toyota's RAV4.

Honda SUV

● To say that mini-sport/utility vehicles are merely hot is like saying "Baywatch" bombshell Pamela Lee has nice features. These smaller-than-compact sport/utilities are extremely popular in Japan, and now they are invading the United States. The segment currently consists of the Suzuki Sidekick and X-90, Geo Tracker, Jeep Wrangler, Kia Sportage and the recently released Toyota RAV4. It looks like Honda hits the beach next.

The Honda CR-V, based on the 103.1-in. Civic platform, has just been released in Japan. It will arrive on our shores as a 1997 model. The delay, according to Honda Motors President and CEO Nobuhiko Kawamoto, is due to production limits. "If American Honda asked for the CR-V right now, I couldn't give it to them because it is so popular in Japan," he said. "We are sold out."

The CR-V is powered by an all-new aluminum 16-valve dohc 2.0-liter Four that makes 130 hp and 137 ft.-lb. of torque. A new casting technique allows the engine cylinders to be mounted closer together than before, saving space and decreasing weight.

The engine reaches maximum torque at a rather high 4200 rpm, which will raise a red flag for serious off-roaders. The CR-V's lack of a low-range transfer case only confirms that this little truck is designed more for Main Street than the Moab Trail. Honda's Real Time 4wd system is plucked from the latest Japan-market Integra. The light and compact hydraulic system uses twin oil pumps and multiple-disc clutches, and shifts power automatically to the rear wheels if the front ones lose traction.

Neat features include a pull-out picnic table that stores flat under the cargo floor in the space traditionally housing the spare tire.

Honda's U.S. arm would like to see the CR-V wear a more aggressive look and a lower price tag before arriving here. The goal is a fully loaded price of less than $20,000.



The Infiniti Q debuts this fall: hard-edged look, smaller engine.

Right On Q

This heavily disguised Infiniti Q prototype puts fears to rest that the luxury division's new flagship would be identical to the Japan-market Nissan Cima. The Cima (see Asia Spy, page 34, Nov. '95) will still provide the platform, drivetrain and suspension for the Q.

The prototype, no doubt powered by the Cima's dohc 270-hp 4.1-liter V8 and 4-speed automatic transmission, has a harder-edged look than the present Q45 and Nissan's Altima and Maxima. The Q will remain rear-wheel drive, and word is that the car will be called simply the Q. It should arrive at dealerships this fall.

The Next Infiniti G20

Infiniti's entry-level sedan, the G20, has been patiently waiting for its replacement. Our spies have seen its progeny, albeit heavily camouflaged. A close peak reveals a family resemblance to the new Q, especially the side mirrors and the shoulder that runs from the base of the side glass to the chrome door handles. The car remains front drive, but a V6—perhaps the dohc 195-hp 3.0-liter Maxima engine—could be in the car's future.

(Please turn to page 41)



G20 replacement gets a new look and maybe even a V6 engine.

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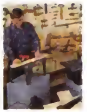


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 (Continued from page 38)

Toyota V8s, Paseo Ragtop

A new version of the Toyota T100 full-size pickup begins U.S. production in 1999. It will be similar to the present vehicle, but will have a slightly extended nose to fit a new optional V8 engine based on the present Lexus dohc V8 design. Displacement will go up to 4.7 liters, and the engine, using an iron block, will be retuned for better low-end torque. Power should be in the vicinity of 250 hp and 300 ft.-lb. of torque. The planned 1999 Land Cruiser and Lexus LX 450 will also get the V8 when they debut.

In the spring of '97, Toyota begins U.S. production of an all-new minivan based on the Camry platform and running gear, with a sales goal of 70,000 per year. The Previa will then be dropped. The new van will have a sliding door on both sides as an option, unless demand warrants it as standard.



Toyota's Paseo convertible—any takers?

The convertible version of Toyota's newest Paseo caught our eye at the Tokyo Motor Show. The top is power activated, and the roofline with the top up mimics the coupe's. The back seat, unusable in the coupe because of limited headroom, remains and—surprise—becomes habitable with the top down. This ragtop could show up just in time to battle Hyundai's new convertible.

1998 Isuzu Rodeo

The slab-sided Isuzu Rodeo and its kissing cousin, the Honda Passport, will be replaced in '98 by a more rounded vehicle.

The overall theme of the current Rodeo/Passport has been retained, while its sheetmetal is totally reworked. The headlight clusters are slimmed down, and the new taillights wrap more smoothly around the fenders. The spied prototype has an aggressive front airdam that houses large air intakes under the front bumper. The grille design is also new. The most prominent design change is the notch in the C pillar, which resembles Nissan's new Pathfinder. The Rodeo's trademark fender flares remain, but they're more subtle.



The 1998 Isuzu Rodeo/Honda Passport gets a softer look.

Hyundai Gets Sporty

This aggressively styled coupe, to be offered by Hyundai dealers this spring, should be a runner. Not based on the lowly Excel, like its predecessor, the Scoupe, this 2-door comes from the new Elantra subcompact (see "New Cars," page 74) and will use that car's front and rear subframes. The coupe will be fwd with front MacPherson struts and rear multilinks, coil springs and anti-sway bars all around. But Porsche has tuned the suspension, optimizing spring rates and rebound, so the new coupe should handle well. Power is from a 2.0-liter version of Hyundai's 16-valve Beta engine, capable of making 180 hp.



PM PHOTOS BY MODEN IMAGE

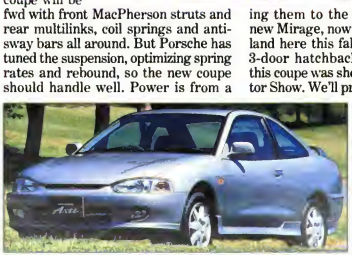
Inside are contoured door panels, white-face gauges and a cockpit-style dash with round air-conditioning vents and rotary climate-control dials. A convertible won't be around until fall '97 as a '98 model. The coupe should cost less than $14,000, and the convertible about $17,000.



Hyundai's new coupe has Porsche-tuned suspension.

'97 Mitsubishi Mirage

Like most Asian automakers, Mitsubishi sells new models at home before bringing them to the United States. This new Mirage, now on sale in Japan, will land here this fall. Sold in Japan as a 3-door hatchback and 4-door sedan, this coupe was shown at the Tokyo Motor Show. We'll probably get the coupe, and maybe the 4-door, as the U.S. sales history of little 3-doors is lackluster. Sharing much of its styling with the new Diamante (on sale in Japan, arriving here this summer), the new Mirage has dual airbags and a dohc Four. PM



Mitsubishi's smart-looking '97 Mirage coupe—a 4-door is possible.

PM PHOTOS (MIDDLE LEFT) BY BILL DELANEY (MIDDLE RIGHT) BY BRENDA PRUDY & CO

Internet TV

BY FRANK VIZARD, Electronics Editor

● Surfing the Net is fast becoming as popular an activity as channel-grazing the TV. And as the Internet moves toward becoming an entertainment medium to rival TV, a number of companies are interested in marrying the two. Picture the Internet as a big-screen experience, a not-so-outlandish notion as more World Wide Web sites adopt sophisticated graphics and video.

One vision of what might be called Web TV comes from RCA. As a candidate for its 1998 line, the company is developing a concept dubbed "Genius TV," a not-too-subtle reference to today's idiot box.

The Genius TV screen is a 35-in. tube, but after that the specifications sound like those of a computer. Imagine a TV with a 6-disc CD-ROM changer built in so you can view multimedia titles on the big screen. There is online access—you cruise the Web in couch-potato style using a wireless keyboard. The TV also has a printer port so you can make a hard copy of anything you want. Internally, the TV is supported by 16MB of memory.

So why can't I get a Web TV today? Aside from the cost—Genius TV would be a whopping $4000 at current prices—a number of technical issues need to be resolved. Later this year, for example, a new crop of super-density (SD) multimedia discs will appear with much bigger storage capacities than current CD-ROMs.

Another issue is connectivity.



Genius TV, a concept model built by RCA, includes a CD-ROM changer and a wireless keyboard that lets you cruise the Internet.



Genius TV looks out for programs on favorite topics.

For instance, how do I get data from my Web TV to my computer? The answer may be what many people are already describing as the RCA jack of the 21st century. Developed by Apple Computer, "Firewire" is a lightweight cable and compact connector offering high-speed digital communication between electronic devices. Officially dubbed the IEEE 1394 standard, Firewire will connect devices as disparate as camcorders and computers (see http://www.skipstone.com for more information) this year.

Oracle, a big name in network computing, says it will soon market a simple TV-like device for Internet access with a price tag of $500. Rather than relying on a beefy array of internal microprocessors, the Oracle device would use advanced software residing on powerful network computers called servers to deliver Internet access via cable modems. Such a machine might be more aptly termed an Internet terminal than a computer.

Meanwhile, NBC is toying with the idea of delivering Web pages via the vertical blanking interval on its television broadcasts. If you combine audio and video with a computer database and deliver it on enough bandwidth, the differences between the Internet and an interactive TV network start to blur. PM

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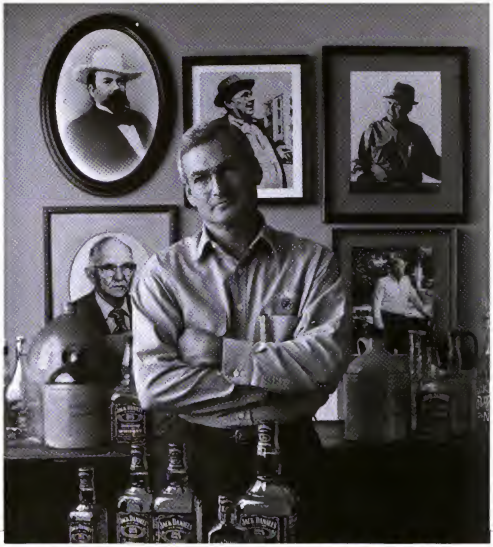
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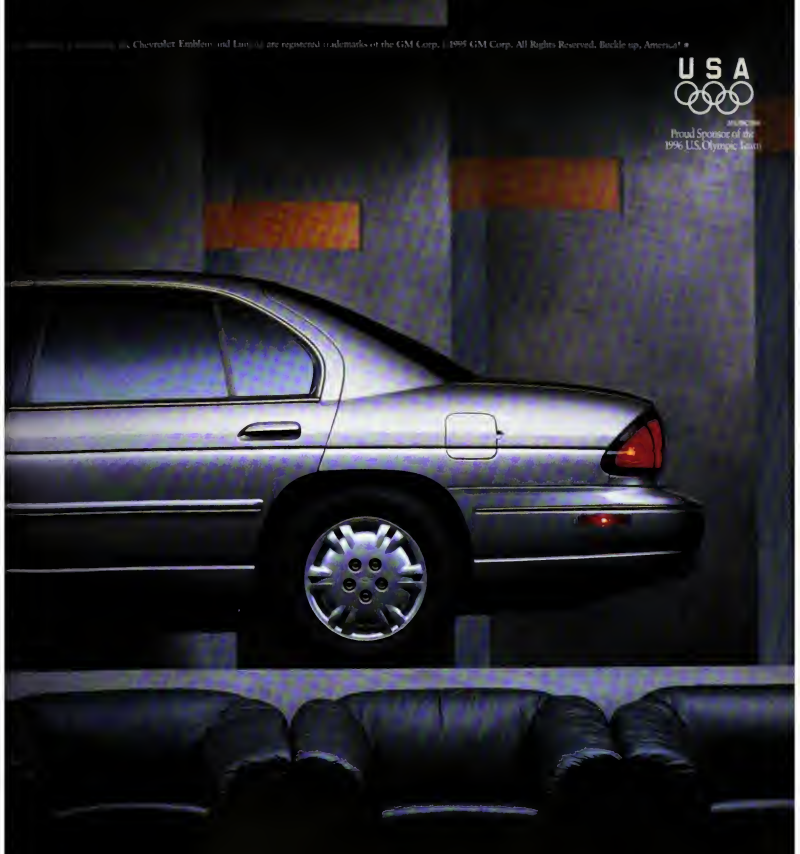
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HIGH SPIES

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BY PHILIP CHIEN

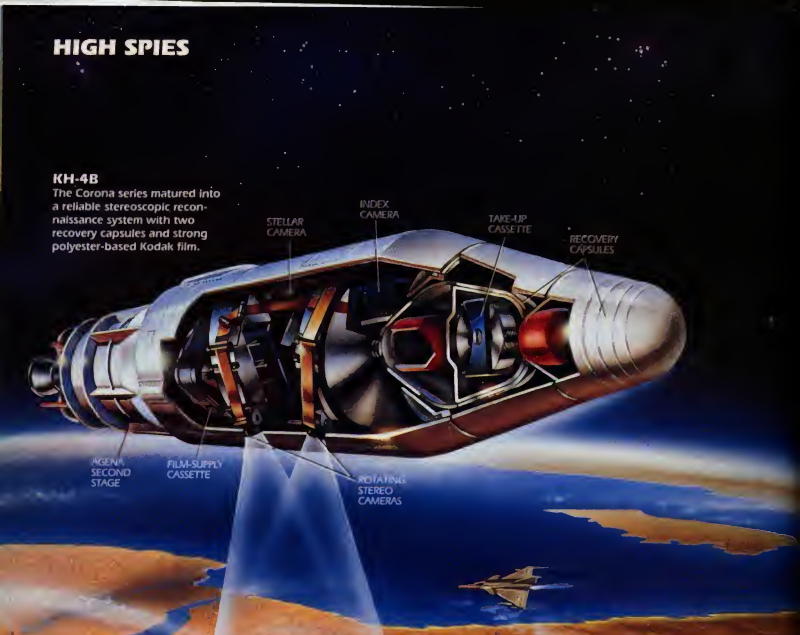


• In March 1994, a remarkable display went up inside the Central Intelligence Agency's headquarters, in Langley, Virginia, where only cleared personnel could view it. The exhibit: a still-classified Corona spacecraft, one of the original reconnaissance satellites of the 1960s. At the display's dedication ceremony, then-Director of Central Intelligence Richard Helms remarked that he hoped the satellite would one day sit in the Smithsonian Institution, where Americans could recognize the role Corona played in shaping history.

That day is coming—and probably much sooner than Helms thought. Today, the Air and Space Museum is preparing a permanent display of a KH-4B stereo camera and the reentry capsule used on the very last Corona mission in 1972. On May 24, 1995, the intelligence community posthumously—and quite publicly—honored program manager Richard Bissell and Brig. Gen. Osmund Ritland, who died knowing they were pioneers and heroes but unable to tell their families just why.

All this was set into motion a year ago, when President Clinton issued Executive Order 12951, declassifying images from the Corona program and from two related subprograms. Now, just as Corona

KH-4B
The Corona series matured into a reliable stereoscopic reconnaissance system with two recovery capsules and strong polyester-based Kodak film.



once shed light on our Cold War foes, the declassification is illuminating the clandestine technology that gave us a leg up on those adversaries. Aerospace experts once strained to fathom the hidden workings of the program—just as they puzzle over today's reconnaissance satellites, which remain highly classified.

The Soviet Union's test firing of its first long-range ballistic missile in 1957 is what got Corona off the ground. Although the top-secret CIA/Lockheed U-2 enjoyed success, the spyplane was always one surface-to-air missile away from causing an international incident (which, of course, it did in 1960). So President Eisenhower authorized the CIA to develop photographic-reconnaissance satellites that could soar over "denied territory" with impunity. The Soviets could hardly complain. After all, they had already set a precedent of unrestricted satellite travel four months earlier with Sputnik 1.

Built by Lockheed Missiles and Space, the Corona vehicles operated under the cover name Discoverer. Their purported objectives were scientific—lofting and recovering mice or other biological payloads to learn how spaceflight affected them. But the early Corona satellites turned out to be lessons in futility. The spacecraft, which were launched on Thor-Agena rockets, were supposed to orbit and then eject recoverable reentry capsules containing the exposed film. But Discoverer 1 never reached space—it crashed near the South Pole. Discoverer 2 flew a near-perfect mission, only to dump its reentry capsule in Norway near the Russian border. Discoverer 3 actually did carry mice, but they wound up in the Pacific Ocean.

Because there was no guarantee that Corona's recovery system would function, work took place simulta-

PM ILLUSTRATION BY PAUL TINNARE



KH-11 FOLLOW-ON
Modern photoreconnaissance satellite features a high-resolution digital camera, on-board fuel supplies and a data-relay antenna to downlink imagery.

neously on another system, called Samos. With Samos, the film would be developed aboard the spacecraft, the photos scanned and the data radioed back to Earth. But Samos proved a bust and was dropped after only five test flights.

Early failures didn't faze the Corona team. "In those days we were pioneering everything," recalls Forrest McCartney, a flight controller in the program and now vice president for Atlas and Titan launch operations at Lockheed Martin. "When you couldn't recover the reentry vehicle it was a disappointment, and when you would get tumbling 'birds' it was a thrill a minute. It was pretty exciting—and a lot of fun." Ground controllers originally operated from an industrial park on Page Mill Road in Palo Alto, California. Later, they moved to the Air Force Station in Sunnyvale.

Number 13 turned out to be lucky for Corona. Launched August 10, 1960, its capsule carried not cameras but an American flag—the first man-made object to be recovered from orbit. The vehicle orbited 17 times. A communications foul-up prevented an Air Force C-119 aircraft from snaring the reentry capsule in midair. Instead, Navy divers had to fish it out of the ocean.

The next mission returned pictures—3000 ft. of film, covering 1.65 million square miles of the Soviet Union. The first useful image: a grainy shot of a Soviet bomber base just 400 miles west of Nome, Alaska. Resolution was crude: the camera could only discern objects 25 ft. across. Corona personnel destroyed the historic spacecraft, overreacting to secrecy instructions from President Eisenhower.

Cold War comfort

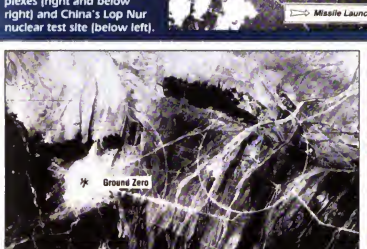
By the time the Discoverer series concluded in 1962, the Corona program had evolved from a problem-plagued effort into a reliable intelligence asset. Corona continued as a classified project for another decade, however. In all, 145 satellites flew into space. Over the course of those 10 years, the resolution of Corona's camera sharpened to 6 ft., stereo cameras were introduced and a second "bucket," or reentry capsule, was added to permit longer missions with more film.

During its reign, Corona's achievements proved pivotal to American foreign policy. A steady return of overhead images kept the Pentagon on top of Soviet missile-site activity. Corona revealed the truth behind the "Missile Gap"—the headline issue in the 1960 presidential campaign. There was indeed a missile gap, but the United States had the upper hand. Furthermore, in 1964, a Corona photograph gave national-security officials a 2-month warning that China was about to join the nuclear club. In 1967, satel-



Specially equipped with poles, lines and winches, Air Force JC-130A plucked Corona recovery capsules from mid-air. Early images included photos of Soviet ICBM complexes (right and below right) and China's Lop Nur nuclear test site (below left).

LOCKHEED MARTIN PHOTOS





NATIONAL ARCHIVES PHOTOS

lite photos of Egypt verified Israel's claims of immense damage inflicted on its Arab adversaries during the Six-Day War.

That same year, President Lyndon Johnson said, "We've spent $35 or $40 billion on the space program. And if nothing else had come out of it except the knowledge we've gained from space photography, it would be worth 10 times what the whole program has cost."

Program officials went to great lengths to keep the project secret. During the space race, any rocket launch attracted national attention, and there was no way to hide the noisy Thor-Agena blastoffs at Vandenberg Air Force Base—especially with a public railroad passing through the facility. To disguise the true nature of Corona, engineers seized on the idea of hiding the spacecraft's camera doors with paper covers attached to piano wire and ping-pong balls. The theory was that, during launch, the rush through the atmosphere would rip the covers away. It worked on a sports car at 90 mph (and garnered a ticket from the California Highway Patrol), but failed on the actual spacecraft.

If the reentry vehicle slipped past its recovery aircraft, it could float so that a ship could rescue it. But to ensure that the capsule wouldn't end up in enemy hands, it was designed to sink after a day. The timer was simply a compressed plug of salt that dissolved steadily until seawater flooded the capsule. Unfortunately, several capsules sank and were lost after otherwise perfect missions.

Although all this imaginative engineering was closely guarded, the press was able to determine many technical details with a fair amount of accuracy. In 1971, *Aviation Week & Space Technology* editor Philip Klass wrote one of the first descriptions of the Corona program. "The only surprises, when everything was publicly released, were how soon the 2-bucket spacecraft were flying and the lack of success of the Samos program," he notes.

Although Corona is now a matter of general knowledge, its descendants—today's photoreconnaissance satellites—are not. They remain highly classified, although the agency that operates them—the National Reconnaissance Office—is now acknowledged. Still, much can be gleaned from unclassified information about the current generation of spy sats.

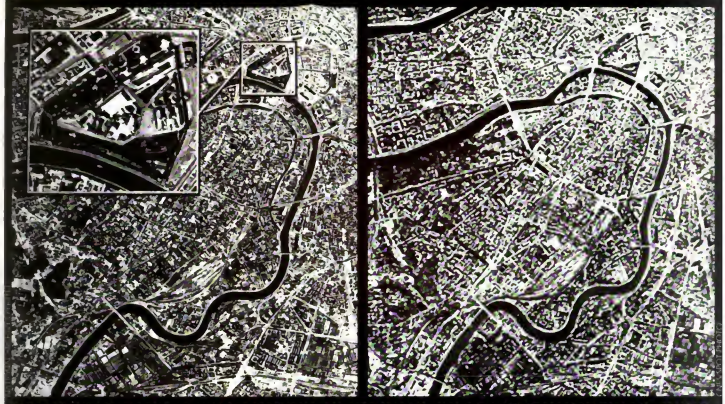
For one thing, it's easy to determine which U.S. launches put up photorecon satellites. Any classified launch from Vandenberg Air Force Base at a compass heading of 189° is almost certainly a photorecon spacecraft. At Vandenberg's latitude and longitude, such a launch would put the spacecraft into a Sun-synchronous orbit at an altitude of 144 miles. A Sun-synchronous orbit allows the spy cam-

era to snap pictures at the same time every day, permitting analysts to note comparisons without having to compensate for changing shadows.

Amateur satellite observers find photorecon satellites easy to track, because they're low-flying and large enough to be seen by the naked eye. Says Ted Molczan, an expert in tracking, "If amateur trackers can produce accurate orbital predictions using nothing more than a pair of binoculars, a stopwatch and a computer, then tracking adversarial satellites should be simple for any country."

As this issue went to press, a classified Titan IV launch from Vandenberg was scheduled for December 5, 1995. It's likely to carry a so-called KH-11 follow-on, a 31,000-pound behemoth with a primary mirror 94 in. across.

At first glance, the satellite might appear to be a twin of the Hubble Space Telescope—facing the wrong direction. There are several major dif-



By the end of the Corona program, resolution had sharpened to better than 6 ft., as seen in a 1970 image of downtown Moscow (left). The resolution of today's best commercially available black-and-white satellite images, from the French SPOT series (right), is only 15 ft.

ferences, though. The Hubble telescope focuses at infinity, shoots dim objects with long exposures and is most sensitive to ultraviolet wavelengths. By contrast, spy satellites are focused only a couple of hundred miles away, take fast exposures with normal lighting and do their best work in infrared wavelengths.

Hubble carries no fuel, whereas photorecon sats have large propellant supplies with which to change orbits and make extra passes over crisis locations. In addition, adaptive optics that compensate for atmospheric blurring—hardware just becoming available on ground telescopes—are believed to be operational on the KH-11 follow-on.

The exact resolution of today's photorecon spacecraft is highly classified. But 2 in. is not beyond technology's reach. The capability of the current series is the subject of many legends—such as its purported ability to tell apart Iranian mullahs by the shapes of their beards. If a license plate lies flat on the ground, it could probably be read, but other claimed capabilities are more myth than fact.

Although it has been reported that some reconnaissance satellites were designed to be refueled by the space shuttle, that feature has never been implemented. In an October 1984 mission, shuttle astronauts practiced refueling techniques while NASA claimed that the procedures could be used to refuel the Landsat 4 and 5 spacecraft (in fact, Landsat's orbit changes so little that it has enough fuel to outlast its electronic components). After *Challenger* exploded, the Air Force mothballed the shuttle launch pad at Vandenberg, killing the option to refuel in orbit.

So current spy sats are launched with a fixed fuel supply and deactivated after the fuel is exhausted. At the moment, there would appear to be enough Titan IV rockets allocated to the KH-11 follow-on to permit the series to operate through the year 2010. The next generation will be smaller and cheaper—and more agile. For many years, military planners have realized that any Third World country with a Scud-class missile and an accurate guidance system can destroy a low-Earth-orbit satellite.

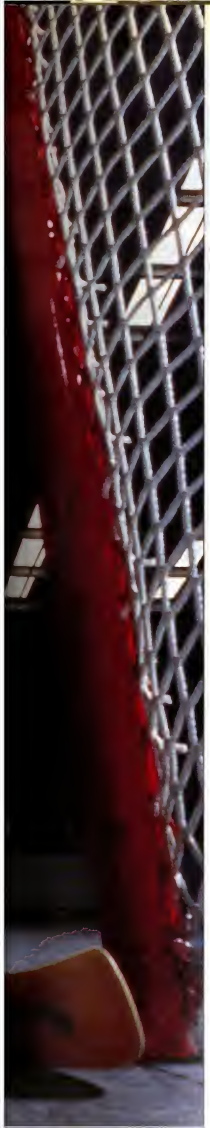
The Air Force's partially classified Miniature Seeker Technology Integration (MSTI) program has tested a variety of sensors, including state-of-the-art digital cameras, on small spacecraft. A production version of the MSTI satellite could be built in large numbers, with some form of quick-launch capability, such as the Taurus rocket (see Tech Update, page 18, June '94), and it could transmit tactical information directly to military commanders in the field.

Spy satellites, one could argue, prevented the Cold War from turning into World War III. Today they play key roles in international armaments treaties and policy decisions. No matter what shapes the next generation take, they'll continue to be America's most prized—and tightly guarded—space assets. **PM**



Its mission known only as USA 86, this 1992 Titan IV launch deployed a KH-11 follow-on


PowerBar



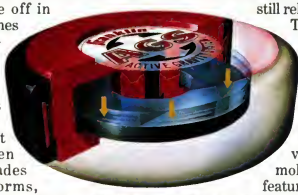
DE-ICING THE PUCK

Roller hockey takes off with high-tech gear designed for the sport.

BY ANDREW GAFFNEY

● If you live in one of the many neighborhoods where they've torn down the net at the center of the local tennis court and replaced it with a goal at both baselines, then you're a witness to the invasion of roller hockey.

Once a game confined to frozen ponds and indoor ice rinks in Canada and the northern United States, the on-wheels brand of hockey is spreading like wildfire across the country. From parking lots in the Sunbelt to surfside areas in California, well over 5 million people will face off in roller hockey games this year on indoor courts and outdoor surfaces that are now being referred to as the "black ice."



An interior weight keeps the puck on the ground. Different pucks are made for a variety of playing surfaces.

Although street hockey has been around for decades in primitive forms, the recent breakaway growth of off-ice hockey has been driven largely by the popularity of inline skating. Because the 4-wheeled skates are able to closely simulate their ice counterparts, street hockey has become a much faster game played year-round on a variety of surfaces and in any climate.

But unlike the days when a pair of sneakers, a plastic stick and a rubber ball were all the gear you needed to drum up a forward line, today's game sports a high-tech look from head to toe that offers protection as well as the breathability needed for play in warm weather conditions.

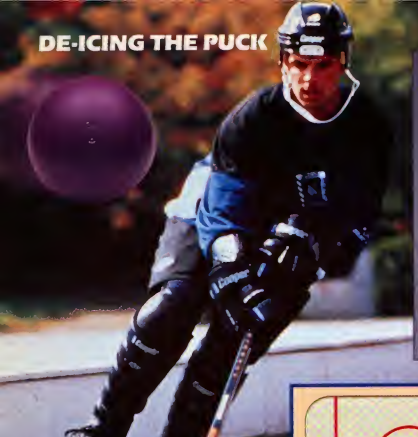
The first and most important item on the gear list for off-ice hockey is a pair of inline skates. But simply having inline skates is not even enough for today's more advanced players. In order to get top performance, serious off-ice pucksters are wearing hockey-specific skates that replicate the look and feel of ice hockey skates, while offering some ventilation.

Entry-level players typically start out with skates that have basic molded boots, because they offer immediate comfort (no break-in required) and are still relatively affordable. Typical of the breed is Rollerblade's Sniper O.T. hockey skate designed to offer the custom fit of a high-end model with the ventilation of a molded boot. It also features a "rockerable" frame, which allows for maneuverability, and Killer Bees bearings in the wheels for speed and precision, all for a retail price of $169.

Because the black ice can be like a second home to a player, durability is also a critical concern. Karhu addresses this with its new Koho Ultimate 2100 skates by offering an abrasion-resistant PVC toe box and PVC abrasion pads on the sides to minimize long-term wear. Modeled after the company's line of ice skates, the stitched-boot skates are sold for around $150.

Experienced players typically choose to lace up more expensive skates featuring stitched leather boots. While

DE-ICING THE PUCK





Skate chassis like these from Motiv Sports are designed for different playing surfaces so you need only one pair of boots.

stitched skates are typically stiffer and require a break-in period, ultimately they provide the custom fit many advanced players desire. For instance, the Professional Composite indoor roller hockey skate from Bauer, a leading maker of both ice and inline skates, features a stitched leather boot with a Clarino synthetic leather lining and Formfit vented tongue that helps dissipate heat and moisture buildup during play. In addition to comfort, the skate provides plenty of perks under the hood as well, including an aluminum frame with a rockering system that allows the front and back wheels to move inward and outward. However, top-of-the-line skates like this come with a pretty hefty price tag of $530.

Even after spending that kind of money for a high-end hockey-specific





Rules Of The Game: Ice vs. Concrete

	National Hockey League	Roller Hockey International
Number of players on surface at full strength	Six	Five
Minimum number of players after penalties	Four	Three
Playing surface size (Std)	200 × 85 ft.	200 × 85 ft.
Board to goal line	11 ft.	15 ft.
Penalty time	Minor: 2 minutes Major: 5 minutes Misconduct: 10 minutes Game misconduct	Minor: 1½ minutes Major: 4 minutes Misconduct: 10 minutes Game misconduct
Fighting penalty	Major	Major, suspension from remainder of game plus next game
Two-line passes illegal	Yes	Only one center, no blue line
Icing	Called when defensive player touches the puck	Illegal clearing, automatic whistle as puck crosses line
Puck	Black rubber, 5½-6 ounces	Red plastic, 3½ ounces
Surface	Ice	Concrete
Referee system	1 referee, 2 linesmen	1 referee, 2 linesmen
Length of game	3 20-minute periods	4 12-minute quarters
Goal cages	4 × 6 ft.	4 × 6 ft.
Number of players	20, 2 goalies plus 18	14, 2 goalies plus 12
Power-play situations	5 on 4, 5 on 3, 4 on 3	4 on 3, 4 on 2, 3 on 2
Average goals per game	7	16.7
Average shots per game	60	96
Overtime	5-minute regular season, sudden death in playoffs	Shootout
Touch-up rule	None	All members of team with man advantage must touch center line if puck is iced

SOURCE: IHH

PM ILLUSTRATION BY KURT HOMM

The Puck Stops Here

Unlike ice hockey, roller hockey is likely to be played under warm conditions. Protective gear must prevent injury but also induce ventilation. The gear pictured here uses ventilated foam padding and vented high-impact plastic to accomplish both tasks. The arrows indicate airflow.



model, many off-ice players still elect to invest more in their tools of trade by customizing the skates even further with replacement components.

The most common upgrade is to the wheels themselves. There are specially designed wheels made for every type of off-ice hockey surface. Soft wheels are generally recommended for outdoor blacktop, while hard wheels are better suited for indoor courts. Hyper, one of the leading aftermarket wheel suppliers, even offers a wheel endorsed by the National Hockey League. Its Pro250 model utilizes virgin urethanes to achieve just the right mix of durability and grip.



In addition to spinning new wheels, many players also up the ante by replacing the chassis (or frame) that mounts the wheels to the boot. Looking for maximum durability and maneuverability, topnotch players invest in aircraft-grade aluminum frames. For example, Sure Grip's H305 frame is constructed of 7000-grade aluminum—the strongest used for skates—and retails for $125.

Chasing a touch of added speed and maneuverability for breakaways, some highly skilled players are even using frames that add a fifth wheel to the skate. Labeda's 5-wheel Predator frame uses smaller 60mm wheels, as opposed to the traditional 72- or 76mm, to achieve sharper turns and quicker acceleration. Also offering the option of a fifth wheel, Konki Sports' new KSL Power 545 aluminum chassis allows players to skate with either four or five wheels.

Once the wheels have been taken care of, players have to make sure they are outfitted in suitable protective gear. While buckling up shinguards and elbow pads may seem like a simple enough task, keep in mind that many players are taking slap shots under the scorching sun of Florida or California. Needless to say, ventilation becomes a critical issue for off-ice players. Protective gear for the pavement must look and perform like equipment for the ice, but also be lighter and include wicking materials for increased ventilation.

Franklin's Air Cooled Design gear, for example—which includes a complete line of pads for goalies, forwards and defensemen—is made with ventilated foam padding, breathable nylon mesh and vented plastic. Similarly,

(Please turn to page 110)



CHEVROLET BLAZER LT

LONG-TERM TEST CARS

We're parting company with three of our favorites.

Chevrolet Blazer LT

● The purpose of a long-term test is to determine how a vehicle performs over the long haul. You know, see what breaks, what falls off and what doesn't, and how the vehicle performs in the daily grind of life. After a year with our long-term Chevy Blazer LT and more than 21,000 miles, we're still waiting for something to break or fall off. Even if we kept the Blazer longer, we think we'd have a very long wait. This is a quality-built vehicle that is as solid today as the day we took delivery. And believe us, we haven't pampered this truck.

TEST SUMMARY: CHEVROLET BLAZER LT

Report number: 4
Total miles driven: 21,885
Miles driven since last report: 8809
Average fuel economy: 16.9 mpg
Worst observed fuel economy: 15.1 mpg
Best observed fuel economy: 19.7 mpg
Maintenance/repair costs: none

It has seen its share of rutted dirt roads—not by choice but thanks to excessive road construction around the old homestead. It has also spent considerable time in 4-wheel drive, thanks to a full winter of driving plus the traditional fall nor'easters.

Yes, this is a tough truck, but it also continually coddled us with its LT leather interior.

Other notes: After all these miles, we still don't like the Premium Ride suspension package. It's just too soft. And we still marvel that so much power (there's even more for '96) can come from a V6 engine. No, you don't need a V8, except for bragging purposes.

Bye bye, Blazer. We sure hate to see you go. —*Joe Oldham*

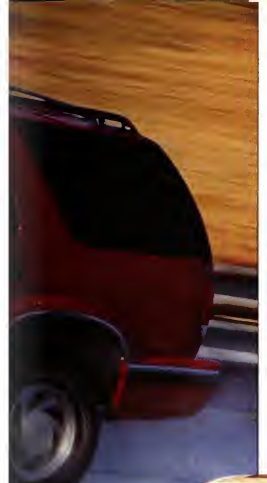
Lexus LS 400

Twelve months and nearly 20,000 miles after we first slipped behind the wheel of our pearl-white LS 400, we have the same reaction we did when we first turned its ignition key: This is one very nice car.

This sedan's delicious combination of spacious luxury and agile, potent performance makes it a great drive and a great ride. When one of our staffers was faced with a late-summer dash from our New York offices to Florida and back, there was no question that the Lexus would be the vehicle of choice. The blast down I-95 and back was accomplished quickly, supremely quietly and at better than 25 mpg. The dual-zone climate control kept both front-seat occupants comfortable despite the blazing sun roasting only half the car at a time. And with a fully loaded spare 6-disc cartridge, the in-dash CD player cranked out more than a dozen hours of music.

Yet, despite the LS 400's air of stately high performance and silent leather-and-wood luxury, it has devel-

PM PHOTO BY GREG JARUM





FORD CONTOUR SE

caused by a tire imbalance. After charging us to rebalance and rotate the tires, the vibration remains. We also learned a lesson on the cost of maintaining and servicing a luxury marque automobile on the island of Manhattan. The regular service for the LS 400 cost almost five times what it did to service our Ford Contour.

TEST SUMMARY: FORD CONTOUR SE
Report number: 3
Total miles driven: 13,393
Miles driven since last report: 6746
Average fuel economy: 25.3 mpg
Worst observed fuel economy: 17.8 mpg
Best observed fuel economy: 36.8 mpg
Maintenance/repair costs: scheduled 12,000-mile service, $76.84

LEXUS LS 400

oped some chinks in its seemingly impenetrable armor. For one thing, the usually accommodating steering wheel would sometimes forget to get out of the driver's way after the ignition key was removed and, worse, sometimes forget to get back into driving position when the key was inserted. Unfortunately, the technicians at Manhattan Lexus were unable to find a problem with the system. They also claimed that the vibration we felt accelerating through 2500 rpm was

TEST SUMMARY: LEXUS LS 400
Report number: 4
Total miles driven: 17,438
Miles driven since last report: 7326
Average fuel economy: 21.7 mpg
Worst observed fuel economy: 16.1 mpg
Best observed fuel economy: 26.5 mpg
Maintenance/repair costs: scheduled 15,000-mile service, balance and rotate tires and replace wiper blades, $378

But, despite these imperfections, we're going to miss that incredibly quiet and smooth passenger cabin, and we're surely going to miss that marvelous 32-valve 4-cam 260-hp V8 engine. That conservative-looking LS 400 has shown its twin tailpipes to many more than its share of racier-looking rides. *—Don Chaikin*

Ford Contour SE

After racking up nearly 7000 miles on our Contour in four months, we can honestly say that Ford accomplished what it set out to achieve with this new midsize family sedan. The leather-clad interior of our SE is seamless—right down to the well-concealed fold-away cup holder that pops up like an antenna at the slightest touch. Wind noise is at a bare minimum, thanks to a sleek, rounded exterior. And the smooth-shifting 5-speed manual works so well with the V6 engine that it lets you slip in and out of traffic with minimal effort.

All is not perfect, however. Depending on who is driving, there are a few nits to pick. Taller drivers, for example, have found the nonadjustable steering column frustrating. In addition, the extra-sensitive 4-wheel disc antilock braking system and all-speed traction control are appreciated by one editor, yet considered annoying by another who thinks New York City potholes would be much more manageable with these systems turned off.

Other complaints focus on certain control features that could stand some ergonomic improvements. The convenient positioning of the cruise-control buttons on the steering wheel does not make up for the lack of an indicator light to let you know whether or not the system is engaged. And the single toggle switch for the electronic open/tilt sunroof requires too much fuss to get the roof to tightly seal shut. Plus, maneuvering around the extra-small buttons on the stereo system is much too distracting.

These are only minor inconveniences, however, when compared to the overall quality driving experience the Contour offers. *—Deborah Frank*

Nissan Maxima SE

Los Angeles stop-and-go driving is severe duty, according to Nissan, so

PM PHOTOS BY GREG LAREM



NISSAN MAXIMA SE

every 3000 miles our Maxima was in need of an oil and filter change. But after 25,000 miles our patience had worn thin with Santa Monica Nissan. It's the kind of place where you feel like a number. And they take all day to perform a simple oil and filter change. So, for our Maxima's last servicing, we decided to give another dealership a chance. Nissan of Temecula is the complete opposite of the Santa Monica store—it's smaller, the workers smile and they completed our last oil and filter change in half an hour. We didn't even have an appointment—we just drove on in. Not all Nissan stores are created equal.

TEST SUMMARY: NISSAN MAXIMA SE
Report number: 4
Total miles driven: 25,632
Miles driven since last report: 10,345
Average fuel economy: 25.3 mpg
Worst observed fuel economy: 16.5 mpg
Best observed fuel economy: 31.5 mpg
Maintenance/repair costs:
scheduled 15,000-mile service, $194.00;
18,500-mile oil and filter change, $21.29;
21,500-mile oil and filter change, $21.29;
25,000-mile oil and filter change, $23.17

driving. Finding as much fun with four doors elsewhere would force you to shell out almost twice the Maxima's asking price.

Ergonomically wonderful, except for the missing back-seat ceiling hooks and front-passenger power-door-lock button, Maxima's awesome highway range of more than 400 miles between fill-ups is done comfortably—as long as your bladder holds out.

As the black sedan leaves us, after traveling more than 25,000 POPULAR MECHANICS miles, it still feels like a new car. The clutch take-up is strong, the brakes aren't close to needing replacement and the car's interior and paint are like new. We're still waiting to hear the first squeak or rattle.

One last smoky burnout and we wave goodbye. This car will be missed.

—Scott Oldham

Volvo 850 Turbo Wagon

We're largely happy with the 850, especially when driving it on the open road and smooth pavement. The turbo makes lotsa power, and the fat, low-profile Michelins stick to the ground like chewing gum on a Hugo Boss suit. The car is fast and fun, the stereo is awesome and the fuel economy is much better than it has a right to be. The cloud surrounding that silver lining is the harsh ride, which undoubtedly exacerbates the cacophony of squeaks and rattles echoing around the interior. Fun it ain't, skittering across the tops of the potholes in the Big Apple.

TEST SUMMARY: VOLVO 850 TURBO WAGON
Report number: 3
Total miles driven: 13,989
Miles driven since last report: 7342
Average fuel economy: 20.9 mpg
Worst observed fuel economy: 19.9 mpg
Best observed fuel economy: 23.7 mpg
Maintenance/repair costs: scheduled 10,000-mile service, $225

The 850 has accumulated enough miles to go in for its 10,000-mile service and, my, what a surprise that was. Two hours of technician time seems like a lot for an oil change and a look over, but not out of line for a complex, turbocharged car. And we expect to be hosed on the hourly charges here in the city, at $77/hour. But neither we—nor Volvo—expected the dealer to tack on an additional $22.05 for additives and washer fluid. Volvo does not recommend that fuel-injection cleaner be added unless there's a real reason to suspect the injectors are actually dirty. Nor do they recommend putting any oil additives in the crankcase. But there they were on the bill, and the dealership—Martin Volvo—was not listening to our arguments, especially if we wanted back our car. To add insult to injury, they charged $1.75 a *quart* for windshield washer fluid that you can buy at Wal-Mart for $1.29 per *gallon*. Next time, we'll be looking very carefully at the estimate. And you can be sure it'll be at a different dealer.

We've also further investigated the never-say-off headlights. To our—and Volvo's—surprise, they can be shut off with the ignition key carefully positioned in the ACC spot—which has no detent. But at least it can be done.

—Mike Allen



VOLVO 850 TURBO WAGON

The pleasure of driving the Maxima far outweighed our service blues. Whether banzai-running to Vegas for a weekend of things mom wouldn't approve of, or ripping through the 5-speed gearbox and the V6's rev range to blow by some wealthy gent in his V8 Q45, the Maxima promotes

PM PHOTOS BY BILL DELANEY

TALK TO ME



New pagers let you listen to messages anywhere—and send one back.

BY GEORGE MANNES

• I'm out running errands one Saturday afternoon when my new pager starts vibrating. Now that alphanumeric pagers are more popular than ever, I'm not awe-struck to see a text message on my pager's display screen —"Can you pick up a gallon of milk while you're out?"

But my response is still novel. From a list of choices displayed on the pager's LCD readout, I push a button to select the reply "Yes/OK." Within a few moments, my pager wirelessly transmits this message to the nationwide network operated by SkyTel. Back at home, my answer pops up on the screen of the computer from which my wife sent her shopping request. Thanks to a recent innovation, the pager that's clipped to my belt does not just receive messages. It can send them, too.

The SkyTel 2-Way pager, expected to be followed by similarly responsive models from other operators, is only one of several exciting new developments in paging. Cheaper to use than cellular phones, pagers are already being used by an estimated 30 million people nationwide. The next generation of pagers is arriving and they have a whole new look. In fact, some of them can even talk to you.

Based on technology developed by Motorola, the SkyTel 2-Way allows people to send a text message to a pager in a variety of ways: A caller can dictate a message to a live operator, use a special SkyTel program on a Windows-based computer con-

nected to a modem or transmit via electronic mail over the Internet. Messages can be up to 500 characters long.

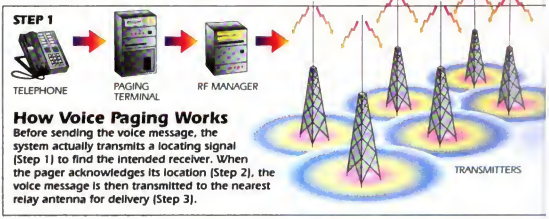
To respond, the person carrying the pager picks from 16 standard replies, including "On my way," "Traffic delay" and "Where are you?" Alternately, the sender can supply brief customized answers. That makes possible a message like "What do you want me to pick up at the video store?" and its reply, "'Batman,' 'The Bridges Of Madison County' or 'Die Hard 3.'" The person who sent the original page can learn the response—or just find out whether the message was delivered—by calling into SkyTel again or checking through a computer.

As an alternative to text paging, the SkyTel system also lets people leave voice mail for paged customers, who are alerted to phone SkyTel to listen to the message. Afterward, they can leave their own voice message for the original caller to hear the next time he or she phones SkyTel.

Introduced last fall, SkyTel 2-Way starts at $24.95 a month for regional coverage and $74.95 a month for national service. The pager itself costs an additional $15 per month to lease or $399 to purchase.

SkyTel 2-Way debuted on a part of the wireless spectrum recently established for advanced paging services. And it employs an RF protocol, or wireless transmission system, that was developed especially for these new frequencies. Meanwhile, Nexus Telecommunications Systems has developed 2-way paging technology it says can be more easily integrated into existing paging networks.

In the Nexus system, messages travel to the pager in the same manner as traditional one-way messages. But according to Nexus, replies from the pager use frequencies that are not traditionally utilized by pagers—the same 900-MHz frequencies used by new, spread-spectrum digital cordless phones.



How Voice Paging Works

Before sending the voice message, the system actually transmits a locating signal (Step 1) to find the intended receiver. When the pager acknowledges its location (Step 2), the voice message is then transmitted to the nearest relay antenna for delivery (Step 3).

The Nexus pager will make it easy for small companies to offer 2-way paging, according to Tom Poulos, vice president of sales and marketing for American Paging, a Minneapolis-based paging operator that is in a joint venture with Nexus to market the technology. American Paging, which is testing the Nexus system in Minneapolis, Chicago and Orlando, says it hopes its 2-way paging network will be available commercially toward the end of the year. Samsung has a license to manufacture the pagers themselves.

Another system developed for new paging frequencies could jumpstart a type of paging that has proved popular but scarce: voice paging. For decades, some paging companies have offered subscribers what is known as tone-voice paging. If a subscriber receives a message out in the field, the pager emits an alert beep, then plays back a voice-mail message that a caller has left. While more appealing to many subscribers than reading a number or a message off of a pager, tone-voice is extremely uneconomical for paging companies. Because tone-voice pages, like all pages, are sent out to all of the paging company's transmitters simultaneously, sending a data-hogging voice page usually takes up too much space on the airwaves.

That has changed with the In-FLEXion paging protocol developed by Motorola. Instead of blasting a voice message out through all of its transmitters simultaneously, the system first sends a brief locator message throughout the system—essentially asking the pager, "Where are you?" From the pager's "I'm here" response, the system determines the antenna closest to the pager, then sends the voice message to the pager through that transmitter only, freeing up the other towers in the network to deliver other messages.

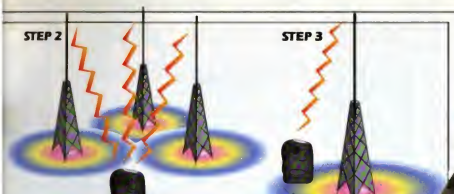
The first company to offer this new type of voice paging will be Plano, Texas-based PageNet, which is now testing its service, dubbed VoiceNow, in Dallas, San Francisco and New York City.

PageNet won't be calling the VoiceNow units pagers, though. Instead, the company refers to them as portable answering machines—actually, a pretty good description. Callers wanting to send a message to a VoiceNow subscriber will be able to leave a brief voice-mail message. Once the network locates the pager, it will transmit the message and alert the user.

The Motorola Tenor pager employed by PageNet can hold



ReadyTalk is a pager-size device that uses the cellular phone system to send voice mail. The receiver can hold up to 12 minutes of audio, and you can use it to receive and respond to voice messages. It is not designed for real-time conversations.



up to 4 minutes of messages. If a subscriber receives voice mail when the pager memory is full, the messages can be held for later retrieval once some old messages are erased. In a recent demonstration, audio quality was scratchy but comprehensible.

Pricing for VoiceNow hasn't been set yet, but it's expected to be at least $20 per month. It is scheduled to go on the market by midyear.

Receiving voice mail on a pager-size device is great, but using the same device to send voice mail is even better. Two-way voice paging is possible through the ReadyTalk system that was scheduled to start testing in December in Mobile, Alabama, Fort Lauderdale and Philadelphia. The most visible portion of the system is the ReadyTalk receiver, which looks like a shrunken cellular telephone without a numeric keypad. The backbone of the system is the local cellular telephone network, rather than the paging frequencies used by PageNet's VoiceNow.

A caller who wants to reach a ReadyTalk subscriber calls a number and leaves a voice-mail message. Within minutes, the message is sent to the receiver, squeezed in among normal, real-time cellular calls. When the message arrives, the receiver—which can hold more than 12 minutes of audio—beeps or vibrates like a pager, and a user can listen to the message anytime thereafter. Then, he can answer the message by speaking into the receiver. The response travels back over the cellular network to a voice mailbox where the original caller can phone in to hear it.

ReadyTalk subscribers will even be able to initiate messaging among themselves, according to developer ReadyCom of Chapel Hill, North Carolina. Each handset can store the numbers of nine other ReadyTalk subscribers, any of which can be dialed with the press of a button.

Expected to be priced at $20 to $30 per month, ReadyTalk could be an economical alternative to heavy cellular telephone use. Many mobile professionals, though, already economize cellular bills by toting a pager for incoming messages along with their phone.

To reduce the hardware these power users have to carry, Motorola is combining the pager and cellular phone into one unit. More precisely, the $259 RSVP pager is a nickel-metal-hydride battery with a numeric pager built in. The RSVP unit can power any MicroTAC or other pocket cellular phone from Motorola.

SkyTel 2-Way pagers not only let you receive text messages, but let you answer them as well. You can choose a stock reply or make up your own.

Motorola's RSVP unit combines the functions of both a pager and a cellular phone. The idea is that the more economical pager can be used to offset the cost of incoming cellular phone calls. RSVP also reduces the amount of hardware a road warrior has to carry.

If developments like voice paging, 2-way paging and cellular/paging hybrids seem pretty cool, just you wait. Paging may go global soon. That's the promise of Axcess Global Communications, in Metairie, Louisiana, which plans to sell paging service in the United States this year using little receivers made by Panasonic.

Instead of building a network of paging transmitters to blanket the country, Axcess Global will broadcast pages via FM radio frequencies across the country. The signals will be carried by the Radio Broadcast Data Service, the same system that enables stations to send data about the songs they're playing for display on listeners' home radios. The advantage of FM radio, says Axcess Global president Robert Adams, is that its frequencies are the same around the world. So Axcess Global, which operates in 22 countries right now, including Mexico and India, will eventually be able to offer local, regional, national and international paging. (Though Axcess Global plans to offer nationwide U.S. service next year, its initial rollout will cover only 11 western states.)

With this kind of reach, the ubiquitous pager may just become the wireless communications device of the near future. PM

PM ILLUSTRATION BY KURT NOVAK



WAGON WINNER

Our Save The Wagons Contest generated a landslide of entries. Here's the winner of the new Buick Roadmaster.

BY CLIFF GROMER, Contributing Editor

● The idea was to try to save the big wagons, already relegated to the endangered species list because of inroads made by minivans and sport/utility vehicles. We are particularly fond of this genre of vehicle because of its hauling and performance capabilities, and we thought that enough car owners might feel the same way. Enough, perhaps, to keep the big wagons from disappearing from new-car showrooms. So we came up with our Save The Wagons Contest.

The rules were simple. Entrants had to tell us in 50 words or less why carmakers should continue to make big wagons. The prize was a brand-new Buick Roadmaster Estate Wagon provided by Buick. This luxohauler is loaded with a 260-horsepower LT1 V8, 4-speed automatic transmission, power steering, windows and door locks, seating for eight, dual 6-way power front seats, self-leveling suspension, 5000-pound towing capacity, dual airbags, antilock brakes and oodles of luxury features.

We were right about one thing. There are a bunch of you out there who love big wagons. A landslide of mail—just under 10,000 entries—swamped our offices and was eventually read and judged by PM's automotive editors. We even had to call our West Coast- and Detroit-based editors in to the New York office to pitch in. Empty pizza boxes and soda cans piled up in our conference room as bin after bin of contest entries was emptied on the big table to be read and evaluated. After several days, we came up with a selection of finalists. Then, POPULAR MECHANICS Editor-In-Chief Joe Oldham flew out to Buick Motor Division World Headquarters in Flint, Michigan, to meet with the vice president and general manager of Buick, Ed Mertz. Together, they judged the finalists and picked the winner.

In the end, it was the highly cre-



Joe Oldham and Ed Mertz present Joan Zettel, and her husband John, with a brand-new Buick wagon.

ative and original entry of Joan Zettel that was the clear standout of the lot. Joan, her husband, John, and their five children live in Breckenridge, Minnesota, a small town of 5000 people that has one flashing traffic light. Joan works as a librarian, a job she's had for eight months after spending 14 years at home raising a family. With their current family hauler, a 1986 full-size Pontiac Parisienne wagon with 186,000 miles on the clock, running on borrowed time, the Zettels were considering replacing it. Up until now, a "new" car to Joan and her husband meant a vehicle with only 50,000 miles.

Joan's prize consisted not only of the brand-new Buick, but also of being flown to Buick headquarters in Flint to meet Ed Mertz and Joe Oldham, and to tour Buick City, where up to 130 Buicks are made every weekday. The trip to Flint for the key-acceptance ceremony was a memorable experience for Joan. "I never even sat in a car with leather seats before," she said. "Or even a new car, for that matter. So we're very excited about winning this beautiful Buick Roadmaster."

The one thing that really impressed Joan was the incredible shine of her new car's burgundy paint. "They don't even shine like that on the dealer's new-car lot," she said upon seeing the car for the first time.

John Zettel also was very pleased. He comes from a family of three generations of Buick owners.

Unfortunately for the rest of us big-wagon lovers, our contest was too little, too late. Despite the almost 10,000 entries, General Motors announced that 1996 would be the last model year for the big rear-drive platform that the Buick Roadmaster and Chevrolet Caprice wagons are built on. So we didn't actually save the wagons, but it was a great contest nonetheless.

Congratulations to Joan Zettel, and watch for our next PM contest. PM



MIND CONTROL

Your next remote control device may be inside your head.

BY FRANK VIZARD, Electronics Editor
PM Photo by Michel Tcherevkoff

● "Relax and kiss me." I'm looking into the eyes of an attractive woman named Helen. Light brown hair, nice figure—a pleasant encounter. I wasn't expecting the direct approach, but I'll run with it. "But if I'm feeling more relaxed, I'll kiss you," she adds.

Whatever. I'm first off the mark. I lean over to kiss her but find myself hesitating just shy of her lips, wondering what kind of reaction I'll get. I'm pulling back. Maybe I need to relax more.

I think about getting a haircut. My barber says I relax in his chair better than any of his other customers—sometimes I'm almost in a coma. This isn't exactly a James Bond maneuver but it's working. I'm chilling. I lean over and plant my lips on hers. Hmm, this is fun. I kiss her some more. Many times more, in fact. Hell, I'm all over the woman.

After a while, though, I expect to be kissed back. She's not making a move. Cold fish? No. She's just impressed.

"Very good," says Helen. "Usually I'm doing all the work."

Gee, that's too bad.

This encounter is mostly taking place in my head. And in Helen's. The truth is we actually haven't even touched one another. Each of us is sitting in a chair wearing a sensor-filled headband. Both headbands are wired to a single computer—at best we're sharing the same input. On the computer screen a couple stands facing each other. The more I relax, the better I'm able to control my on-screen persona. He's been busy.





In this simple demonstration of IBVA mind-control technology, participants maneuver on-screen personas in a kissing contest.

Okay. This is going to be a great bar game someday, but today's exercise is more than a casual flirtation. What Helen and I are doing is a simple demonstration of mind control, the ability to operate devices using the power of thought.

Mind control generally conjures up visions of a futuristic, totalitarian society in which the central government controls every citizen's thoughts. Another favorite scenario features the hybrid alien child next door who fiendishly manipulates the townspeople.

For researchers working in this field, the reality of mind control is perhaps a bit more mundane than science fiction, but exciting nonetheless.

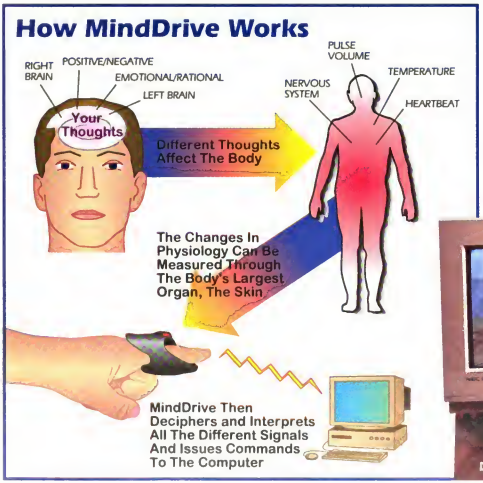
The goal is to tap the power of the human mind, using an electronic interface to control devices. You could, for example, control the cursor on a computer screen, play videogames or adjust the settings on your TV simply by thinking about it. And while mind-control devices are likely to appear first as part of an entertainment package, since that's where the development money is, there is a more serious side to the technology. Mind control would be a boon to people suffering from paralysis, giving them control over their environment to an unprecedented degree. A quadriplegic confined to a wheelchair, for example, would suddenly have complete freedom of movement in a mind-commanded chair.

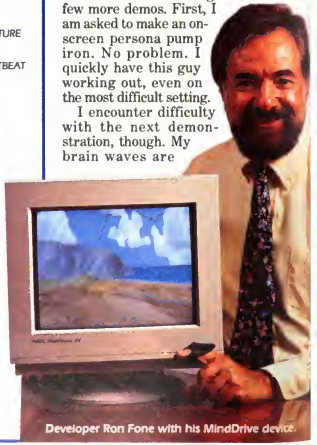
Other potential applications include a vehicle safety system that would be able to detect driver drowsiness or intoxication, and prevent vehicle operation. One of the wilder proposals envisions plants, known to react to people by changes in their electric fields, linked to burglar alarms.

Helen Meschkow, my virtual date, is the customer relations manager for IBVA Technologies Inc., a New York company that has already developed the basic computer software that makes mind control work. IBVA, which stands for Interactive Brainwave Visual Analyzer, sells the software to companies that are developing specific applications.

Helen runs me through a few more demos. First, I am asked to make an on-screen persona pump iron. No problem. I quickly have this guy working out, even on the most difficult setting.

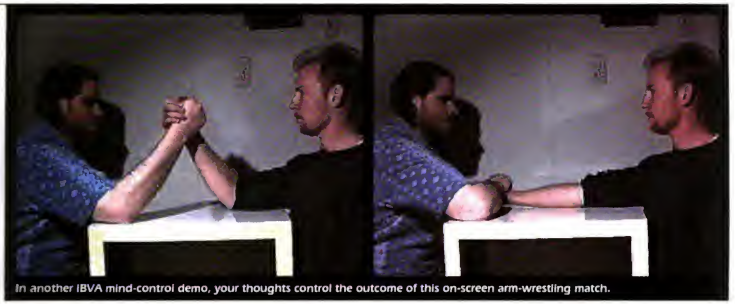
I encounter difficulty with the next demonstration, though. My brain waves are





Developer Ron Fone with his MindDrive device.

ILLUSTRATION BY ROBERT NOVAK



In another IBVA mind-control demo, your thoughts control the outcome of this on-screen arm-wrestling match.

converted to MIDI music files for playback. Think of it as mind music. But instead of producing a symphonic concerto, I'm just a one-note Johnny.

I'm back in form, however, with a 3DO videogame called "Road Rash." I'm controlling the speed of a motorcycle using my mind. I'm driving like a mad biker when the sound of a siren brings me to a halt. A trained societal response, but I find that if I block out the sound of the siren I'm quickly flying down the road again. Good training for reality.

"You're paying for my next speeding ticket," I mutter to Helen.

The funny thing is that I have no idea what my mind is doing. And neither does anyone else. What they do know is that brain actuation varies from person to person. Some people come to it quickly, while others don't—although with practice, performance gradually improves.

Researchers have discovered that there are different types of brain waves—alpha, beta, delta and theta—that correspond to different types of mental activity. The frequency, amplitude and density of these brain waves can be measured. Electroencephalography (EEG) research over the past few decades by such groups as the Armstrong Laboratory at Ohio's Wright-Patterson Air Force Base shows that individuals can regulate their brain waves.

For the purposes of mind control, alpha and beta waves seem to be the most important. Alpha waves, produced by a relaxed but wakeful brain, span the frequencies between 8 and 13 Hz. Beta waves, produced during periods of intense concentration, have frequencies between 13 and 30 Hz.

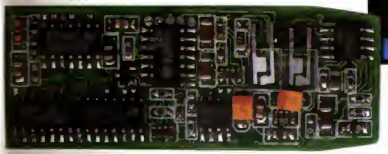
Capturing what's going on in your head is very difficult. The time it takes you to see something and react to it is about .07 seconds. To home in on a specific frequency and process it quickly requires very fast electronic signal processors, which are just now becoming affordable for inclusion in mass-produced devices.

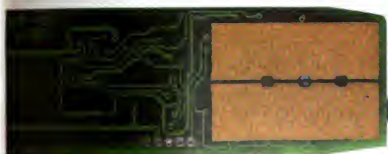
Demonstrating this is The Other 90% Technologies Inc., which intends to market a mind-control device for less than $200 later this year. The Sausalito, California, company's product is called MindDrive, and it's basically a videogame controller.

Unlike the IBVA device, a 4.5-ounce headband containing sensors that attach to the scalp, MindDrive uses a more convenient sensor sleeve that slides over your finger. In this case, the signals being produced by your brain are being read through the body's largest organ—the skin.

(Please turn to page 110)









The MindDrive finger sleeve contains a circuit board that interprets brain waves to run programs such as the Mind Powers game (above).



POWER ON THE LOOSE

Head-turning looks and head-snapping performance put the sizzle in boating's new generation.

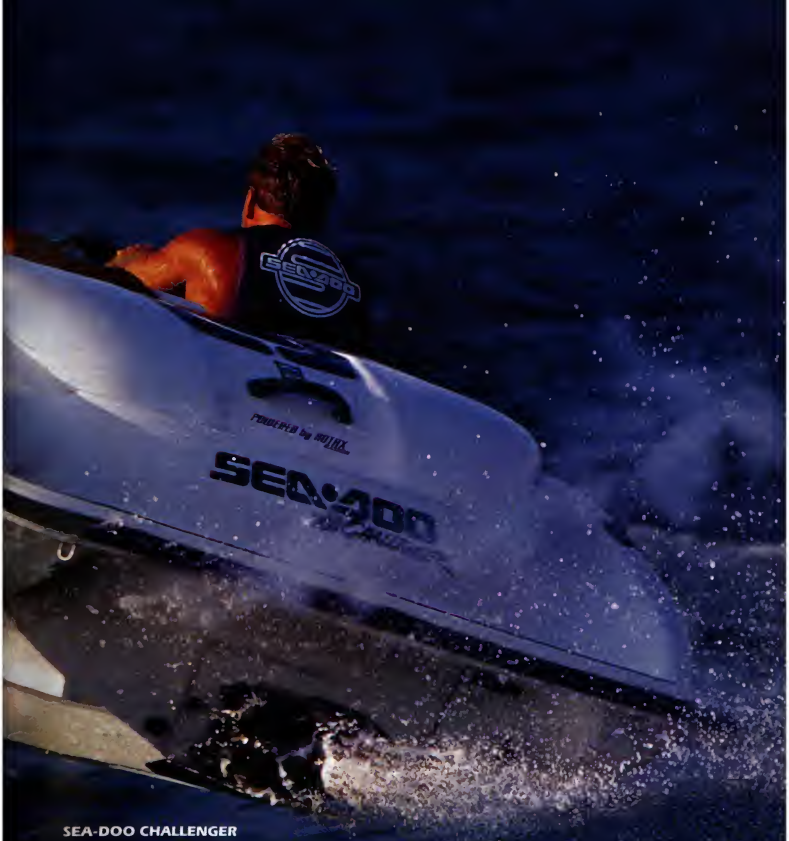
BY JOE SKORUPA, Boating/Outdoors Editor

● Just when you thought it was safe to go back on the water, everything changes. Crowds suddenly become restless. Background music builds. The water begins to boil. Is that a fin slicing through the waves? No. It's just the return of the bad boys of boating—twin-engine jet boats, high-powered personal watercraft and high-performance sport boats. Yes, the most nautically incorrect boats to hit the water are back, and they're giving boating a much needed shot of adrenaline in '96.

Aside from some pockets of excitement found on boating's youth-oriented fringe, the traditional heart of the recreational marine market has been sleepwalking through the '90s.

To be fair, some of the drowsiness was the result of adverse economic factors, but much of it was due to an entrenched, industrywide tendency to play it safe. And by safe, I mean doing things like aping the competition instead of creating something new, heading down the middle of the road instead of the fast lane, scooping up vanilla ice cream instead of Heath Bar crunch and th

Fortunately, things have changed this year and



SEA-DOO CHALLENGER

leading the way is Bombardier Sea-Doo, which is rapidly becoming one of the big dogs of boating. Two years ago, the Canadian-headquartered company roared past Kawasaki and Yamaha to become the No. 1 manufacturer of PWCs. Not satisfied with supremacy in just one market, Sea-Doo then decided to build boats—high-voltage twin-engine minijets. (In recent news, Sea-Doo acquired Celebrity, a maker of medium-size prop-style boats.)

Sea-Doo's initial boat, the Speedster, appeared in 1994, and I tested the first unit off the production line. It accelerated like a rocket and, at wide-open throttle, was 10 mph faster than anything in its class. The new model for '96 is the Challenger equipped with a single 800 Series Rotax, a 2-cylinder 782-cc 110-hp screamer that competes successfully with larger-displacement engines. In the 14-ft. 6-in. Challenger, this engine delivers hole-shot and top-end speeds fast enough to pull wakeboarders and skiers out of the water with impressive quickness. Complete with a trailer and a long list of skiing features, the Challenger retails for $10,199.

When Sea-Doo introduced the GTX in '92, it paved the way for a new class of large, 3-person PWC's. By last year, these big, ultrastable cruisers represented the market's fastest growing segment. To reassert its category leadership, Sea-Doo has thoroughly redesigned the GTX model for '96.

The new GTX is slightly longer and wider this year



SEA-DOO GTX

and, as a result, has a softer, plusher ride. I put it to the test by taking it out on a messy, wind-whipped lake. Even in 2-ft. chop and whitecaps, the ride was dry, stable and comfortable. Equipped with the 800 Series Rotax engine, the big GTX delivers sporty power and thrills for up to three riders.

In addition to being larger and faster, the artistically sculpted GTX ($7299) has a complete instrument package, rearview mirrors and a big 15-gal. fuel tank for long-range cruising. For more information on Challenger or GTX, contact Sea-Doo Division, 730 E. Strawbridge Ave., Melbourne, FL 32901; (407) 722-4000.

Most affected by Sea-Doo's meteoric rise was Kawasaki, the pioneer that nurtured PWCs in the '70s and owned the market in the '80s. Sea-Doo initially blindsided Kawasaki, but the Irvine, California-based company is now in counterattack mode. Last year, Kawie came out with the high-powered, responsive, dry-riding 900 ZXi Jet Ski, which PM and others thought was 1995's high-performance category killer (see "Boiling Water," page 72, May '95).

This year, Kawie strikes again with the 1100ZXi, which I tested recently in the Bahamas. This high-performance 2-seater not only comes with a huge 1070-cc 3-cylinder engine, but with two features never before seen on PWCs: automatic trim and beneath-the-hull air induction.

Kawasaki Automatic Trim System (KATS) monitors the engine's rpm and automatically adjusts the trim up (for optimum planing angle) or down (for hole-shot punch). The system works well and will be appreciated by riders not familiar with using trim.

Firing On All Jets For '96

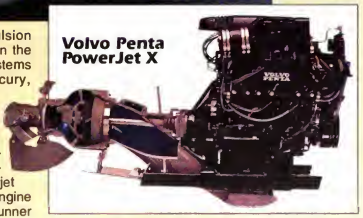


● The popularity of jet propulsion continues to build momentum in the boating world with new jet systems set to debut in '96 from Mercury, Yamaha and Volvo Penta.

In the minijet segment, Mercury Marine is developing a second-generation SportJet drive that will mate to a big 175-hp 2-stroke-cycle V6 powerhead. Yamaha enters the minijet market with a 110-hp 2-stroke engine and drive lifted from its WaveRunner watercraft division.

And most interesting of all, Volvo Penta delivers big-engine power to medium-size boats with the introduction of the PowerJet X, a drive paired with a 200-hp 4.3-liter V6 engine.

As with all marine jetdrives, the PowerJet X draws water through an intake in the hull of the boat and sends it to a multiblade impeller, which then forces the water out a narrow nozzle. The reduction in size of the outlet, combined with a constant flow, forces the water to accelerate and create thrust. Although water is forced through a narrow opening, it doesn't compress, as often explained. The constriction produces acceleration.



One of the unique features of the PowerJet X is a rubber coupler between the engine and the pump that shortens the overall length of the drivetrain by 6 in. This is important because it enables builders to retain the same engine location for the PowerJet X that's used by a standard sterndrive. Other unique features are a rudder fitted below the nozzle to improve steering and a hinged rider plate to adjust trim.

The first boat to be equipped with the PowerJet X is the Wellcraft 19 Scarab Jet, shown at left. Volvo Penta supplied Wellcraft with a mold insert to create the pocket in the hull that's required for the pump intake. This year, Wellcraft has the PowerJet X all to itself, thanks to a close link between the jetdrive technical team and Larry Smith, the guru of Scarab.

The 4-seat, deep-V 19 Scarab Jet is another of this year's top-down, wind-in-the-hair heart pounders. But as an 18-ft.-11-in.-long jet boat, it's a muscle machine with a twist. It shows that jet power is no longer confined to miniboats and belongs in the future of mainstream boating. For information about the PowerJet X, contact Volvo Penta, 11300 Volvo Penta Dr., Chesapeake, VA 23320; (804) 436-2800. For information about the 19 Scarab Jet, contact Wellcraft Marine, 1651 Whitfield Ave., Sarasota, FL 34243; (813) 753-7811. —*Charles Pluedderman*



Kawasaki Air Induction System (KAIS) is a first for a production-line hull. The system takes advantage of aerated water, which offers less friction than water without air mixed in. Kawasaki adds the air by making passageways between the engine compartment and vents on the bottom of the hull. At speed, negative pressure at the vents pulls air into the water, enabling the 1100ZXi to run on low-friction foam.



Although the high-end 1100ZXi ($8299) is equipped with KATS, KAIS, full instrumentation, splash deflectors (which Kawie pioneered last year), head-turning lines, a bold color scheme and every imaginable PWC feature, the big speedster's most impressive characteristic is its ride. Balance of weight and a superb jet-nozzle position (moved back 100mm from other ZXi hulls) combine to give the 1100 blazing top-end speed, booster-rocket acceleration, responsive handling and outstanding stability. The 1100ZXi is the PWC to beat for '96. For more information, contact Kawasaki Motors USA, 9950 Jeronimo Rd., Irvine, CA 92718; (714) 770-0400.

Last year, Yamaha brought the first 1100-series engine to the PWC world, the WaveRaider 1100. It also created the first jumbo-size cruiser, the WaveVenture. This year, it again delivers a one-two punch with the WaveBlaster II sport-class PWC and, from the Yamaha outboard division, the Exciter twin-engine jet boat. Clearly, even more than Kawasaki, Yamaha has decided to get in the ring toe to toe with Sea-Doo and slug it out.

The WaveBlaster II ($6599) features the typically narrow-hull (40.6 in.) design that makes the WaveBlaster marque a corner-pinning champ on the slalom course. The difference with the WaveBlaster II is a larger 90-hp 760-series (754-cc) engine. As with the original WaveBlaster (still available), this sport PWC requires some getting used to, and rewards improved skills.

Fitted with twin engines and having a 55-mph top speed, the Yamaha Exciter (about $15,000) jet boat easily lives up to its name. The apparent intent of the curvilinear Exciter is to deliver more of everything than the competition: more horsepower (220 hp), more size (16 ft. 7 in. long and 7 ft. 7 in. wide) and more standard features (37-gal. fuel tank with 7-gal. reserve, trailer, ski locker, swim platform and a unique jet-pump inspec-





FOUR WINNS U-17

tion port that enables the driver to clear debris without leaving the boat).

Interestingly, Yamaha—like Sea-Doo—is now the proud owner of several prop-boat companies, including Cobia, of Vonore, Tennessee, which builds the Exciter. For more information about the WaveBlaster II or the Exciter, contact Yamaha Motors USA, 6555 Katella Ave., Cypress, CA 90630; (800) 248-9687.

In a clear sign that the times are indeed changing, Bayliner, the king of family boating, has introduced a high-performance sport boat, the Arriva 2552.

This 24-ft.-7-in.-long cigarette-type boat (long and thin with fire at one end) has a sharp 19° deadrise for soft running in offshore waves. And it comes standard with a 5.7-liter 250-hp V8 MerCruiser Sport Series engine with an Alpha drive. However, to truly deliver muscle-boat thrills, the Arriva is rated to handle Merc's 8.2-liter 415-hp 502 Magnum V8 with a dual-prop Bravo 3 drive. As with all packaged-to-the-max Bayliner boats, this model comes with a long list of features and at a competitive price ($29,995). For information, contact U.S. Marine, P.O. Box 9029, Everett, WA 98206; (360) 435-5571.

Tournament-Bred Kingfish Boats



● For years, big-time tournament fishing was spelled B-A-S-S, and to fish competitively the primary tool for anglers was a tournament-bred bass boat. Well, bass tournaments and bass buggies are still very much with us, but there's a new big-time fishing circuit evolving that targets kingfish, and it's in the process of spawning its own highly specialized fishing rigs.

Kingfish, or king mackerel as they are properly called, range from North Carolina to Louisiana, and every state in this zone has one or more kingfish tournaments. The granddaddy of them all, in Jacksonville, Florida, features a whopping $410,000 purse. What kind of boat does it take to win a tournament like this and be competitive on the kingfish circuit?

First and foremost, the boat must be fast. Speed comes in handy to hit the live-bait grounds before others arrive and spook the fish. It's also needed to cover long distances between prime gamefish schools, and to chase down the winning catch once it's been hooked. Second, the boat must feature plenty of wide-open fish-fighting space, and the best way to do this is to use the center-console design. And third, it must be capable of sustained open-ocean operation, which means a deep-V hull to slice through the waves, rock-solid construction to withstand the pounding, reverse chines for a dry ride, a large fuel tank for long-range operation and deep freeboard to provide overall protection in swells.

The boat that currently fits this description like a glove is the Fountain 31 Sportfish Center Console. It's considered by many to be the ultimate kingfish tournament boat and the prototype for a new generation of sport-specific rigs. Built with a race-proven hull and a built-in outboard bracket, the kingfish version of this 31-footer blasts off the shotgun-start tournament line with a pair of Mercury 225-hp engines.

Other essential features on the boat are an elevated bow area for casting and throwing nets, copious rod holders, a 400-quart fish box and a small forward cuddy with a V-berth and a portable head. Equipped with the twin Mercury 225s, the 31 Sportfish retails for roughly $88,000. Big money for a boat of this size, but it's aimed at attracting big-time tournament fishermen who want only the best. For more information, contact Fountain Powerboats, P.O. Drawer 457, Washington, NC 27889; (919) 975-2000. *—Mark Weintz*

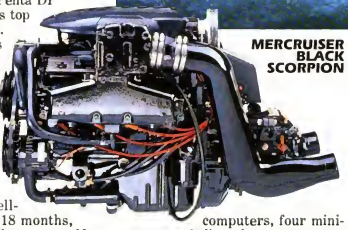
PM PHOTO (TOP) BY FOREST JOHNSON

With a finger on the same hot-boat pulse as Bayliner, family-boat builder Four Winns also debuts a high-performance rocket, the U-17 ("U" is for Unlimited). But even though Four Winns breaks character, it doesn't break tradition. The U-17 is a homage to Don Aronow's classic deep-V Donzi pocket racers of the early '70s—clean lines, absence of windshield, minimal features, sharp 24° deadrise, high-performance stainless-steel prop and, of course, eye-watering speed.

The beautifully finished U-17 comes standard with a 160-hp 4.3-liter V6 Volvo Penta SX sterndrive. Equipped with a 220-hp Volvo Penta DP (DuoProp), it delivers top speeds in the low 60s. Base price for this instant classic is $16,565. Contact Four Winns, 925 Frisbie St., Cadillac, MI 49601; (616) 775-1351.



YAMAHA WAVEBLASTER II


MERCRUISER BLACK SCORPION

While the OMC commitment to direct-injected 2-stroke-cycle outboards has been well-known for the past 18 months, Mercury's plans have been vague. Not anymore. Mercury recently unveiled plans for its first DFI (direct fuel injection) outboard. It will appear in '96 as a midyear intro. The unit will be a 200-hp outboard that adapts technology licensed from and developed by the Orbital Engine Corp.

Mercury's 200 DFI is based on a modified 3.0-liter V6 block. Key elements of the system are a digital electronic control more powerful than many personal computers, four mini-processors dedicated to separate engine functions, rails that carry fuel and air under pressure and injectors that deliver highly stratified fuel/air plumes directly to the spark plugs.

If this system sounds complex, it is and it took many years to develop. However, the effort was worth it. The 200 DFI will operate cleaner, quieter, more reliably and more efficiently than any conventional 2-stroke. Look for a hands-on report in an upcoming spring issue.





A second engine of interest from Merc is the new Black Scorpion tournament waterski engine, which is very much like a small-block dream machine. This 350-cu.-in. V8 is based on General Motors' new Gen+ 5.7-liter engine. It uses high-flow cylinder heads, an aggressive roller-cam valvetrain, custom intake runners, multipoint EFI and water-cooled fuel delivery to produce 315 hp, which is 15% more than last year's 5.7-liter small-block, and 5 to 7 mph more speed in a tournament boat. For more information, contact Mercury Marine, W6250 Pioneer Rd., Fond du Lac, WI 54936; (414) 929-5000, and MerCruiser, 3003 N. Perkins Rd., Stillwater, OK 74075; (405) 743-6505.



SUZUKI 115 EFI

Electronic fuel injection may seem like old hat compared to other recent tech developments, but it's new within the world of smaller engines. For the first time, boaters looking for a midsize outboard with EFI will be able to find one thanks to the new Suzuki 115 EFI. This outboard is based on Suzuki's proven inline 4-cylinder 1.8-liter block, and thanks to a sequential-digital EFI system it displays improved fuel efficiency, increased horsepower, more torque and reduced sound levels.

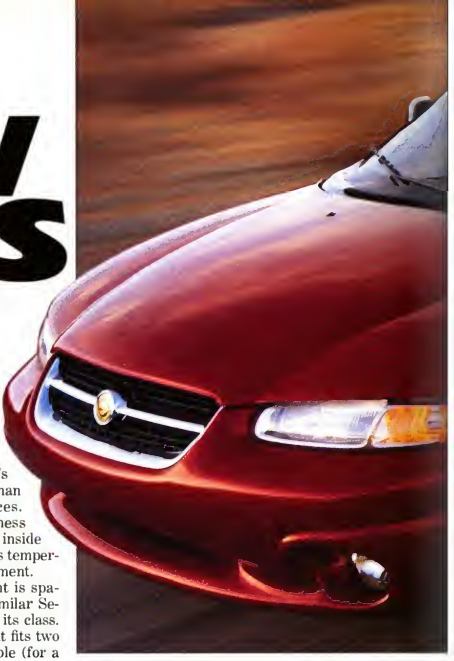
Beyond fuel injection, the new engine has a unique gravity-fed, single-point oil-injection system with a 6-liter oil reservoir tucked under the cowling and an internal clock that cuts the amount of fuel flow when the engine runs for more than 2 minutes at 1500 rpm or less. This latter device, which reduces fuel burn by 30%, is a fishing-friendly feature useful during slow trolling.

While the carbureted Suzuki 115 is still available, the new 115 EFI will be a welcome addition to owners of bass boats, flats boats and other performance hulls in the 15- to 18-ft. class. For more information, contact Suzuki Marine, 3251 E. Imperial Hwy., Brea, CA 92621; (714) 996-7040.

High-performance boats and high-tech engines—what more could you want from boating '96? PM

NEW CARS

More power, more sky, more ritz.



Chrysler Sebring JX/JXi

● Every car company wants a parade car. And everyone knows that the best parade cars have open tops. And right there you've probably got the best explanation for the existence of Chrysler's new Sebring convertible. There is no Dodge version, no Plymouth, no Eagle.

Chrysler engineers say that the Sebring's structure has 80% more torsional rigidity than the LeBaron convertible, which it replaces. Special steel chassis braces help add stiffness and solidity to the body, and a double liner inside the convertible top helps quell noise as well as temperature gain and loss in the passenger compartment.

The convertible's passenger compartment is spacious, much the way the mechanically dissimilar Sebring coupe has a large interior for a car in its class. The Sebring JX/JXi has a real back seat that fits two adults comfortably. And there's a respectable (for a ragtop) trunk, which holds 11.3 cu. ft. of stuff.

The front seats are novel for Chrysler, and the domestic auto industry, in that the front seatbelts are anchored to the seats, in the same way the seatbelts are attached in the Mercedes-Benz SL-Class sports cars. Theoretically, if the belts are attached to the seats, they remain equally comfortable and effective regardless of how the seats are adjusted.

Based on the Cirrus/Stratus platform, the Sebring convertible has a wheelbase of 106 in.—that's 2 in. shorter than the Cirrus/Stratus wheelbase, yet at 193 in. long, it's 9 in. longer overall than the sedan.

The JX is powered by the sedan's 2.4-liter dohc Four, rated at 150 horsepower. The JXi gets the 2.5-liter sohc V6 that yields 164 horsepower. The only available transmission is a 4-speed automatic.

Mercedes-Benz E420

The Mercedes-Benz E-Class has been that automaker's largest model range. The previous-generation E-Class was available as a sedan (with four very different engines and trim levels), a coupe, a convertible and a station wagon. It will take some time for the newly introduced E-Class to build in size to match the size of the old. But the Stuttgart-based company is not wasting time. We recently had the opportunity to drive the next model in the range, the E420 sedan.

Basically, the E420 is similar to the already available E320 and E300 Diesel, but it carries the strong 4.2-liter V8 engine that was used in the previous E420 model and is also used in the larger S420. The all-aluminum 4.2-liter V8 has four camshafts, 32 valves and variable intake-valve timing, and cranks out a serious 275 hp and 295 ft.-lb. of torque.

The V8 engine comes mated to a 5-speed automatic





CHRYSLER SEBRING JX/JXi is based mechanically on the Cirrus/Stratus sedans. The Sebring boasts front seatbelts that are anchored to the front seats, not the body, much like they are in the Mercedes-Benz SL Class.

transmission that features an overdrive (0.83:1) Fifth gear. Mercedes-Benz automobiles have traditionally been equipped with a direct (1:1) top gear.

Hyundai Elantra

Before Hyundai went ahead with the '96 Elantra project, the engineers and designers did their homework. They returned the model's drivetrain to Mitsubishi and replaced it with their own 1.8-liter dohc 4-cylinder and their own transmissions. Buyers have a choice of either a 4-speed automatic or a 5-speed manual.

Hyundai calls the Four the Beta engine. It develops

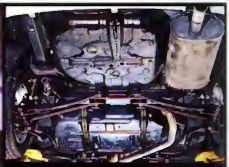






MERCEDES-BENZ E420 has the same new look as the E320, but with a 275-hp dohc 32-valve V8 with computer-controlled variable intake-valve timing and a 5-speed automatic transmission with overdrive. Because of its bodacious 295 ft.-lb. of torque, the E420 comes standard with Benz's *ASR*





HYUNDAI ELANTRA, in sedan and wagon, offers a lot for the money for a compact, including a subframe-mounted fully independent rear suspension.



130 hp at 6000 rpm and 122 ft.-lb. of torque at 5000 rpm, and therefore is one of the stronger engines in the class. It's also smoother than many competitors, despite its lack of a balance shaft.

The absence of the shaft—plus the use of temperature-resistant plastics for the engine head cover, air cleaner and water-pump impeller, and aluminum engine mounts—results in impressive weight savings. Also, the engine's compact profile, which angles the valves at a tight 25.5°, allows for the car's short and low hoodline.

The new engine and the independent suspension—which uses MacPherson struts in the front and a multilink setup with coil springs in the rear—benefited from the company's acquisition of a Cray supercomputer during their development.

All of the key suspension and drivetrain components are mounted to isolated front and rear subframes, which provide a secure and highly stable base to keep noise and vibration from the passenger compartment.

Acoustic foam-filled A, B and C pillars, and new double-layer polyvinyl chloride and polyurethane sandwich materials, have been used in the dash and hood insulation pads and in the rear parcel shelf to reduce noise.

The early prototypes we drove suffered from a spongy brake pedal feel, even in the cars with the optional (on the GLS) antilock braking system. We also found the seats to be too short for long torsos, and the lumbar support, which is not adjustable, feels like somebody is jamming their elbow into your lower back. On the plus side, there's plenty of room, the materials look and feel good, the control placement is first-rate and the a/c is strong.

Dual airbags are standard on all models, and the wagon boasts the most interior volume in its class.

Lexus LX 450

Another luxury-car marque has thrown its logo into the sport/utility ring. Based strongly—very strongly—on Toyota's Land Cruiser, the Lexus LX 450 is to sport/utility vehicles what the ES 300 is to compacts.

So the LX 450 has a 212-hp 4.5-liter inline 6-cylinder engine that develops a house-pulling 275 ft.-lb. of torque. The engine is mated to a 4-speed automatic transmission and a 2-speed transfer case. A viscous-coupling center differential allows for the on-all-the-time feature of the all-wheel-drive system. A manual locking feature is available as an option—the driver can selectively lock the front, rear or center differential, or lock all three.

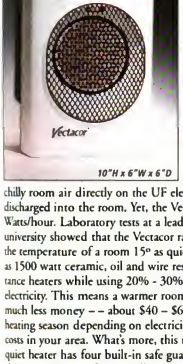
Mechanical refinements include changes to the vehicle's suspension. The LX 450 borrows from the LS 400 sedan to soften the ride. Besides unique spring and shock rates, the LX 450 uses hollow rubber springs inside the coil springs. And the shock absorbers use rebound springs, just like the big Lexus sedan. PM



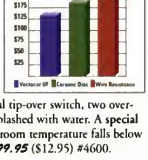


LEXUS LX 450 strongly resembles the Toyota Land Cruiser, even under the hood where you'll find a very stout 4.5-liter inline Six.

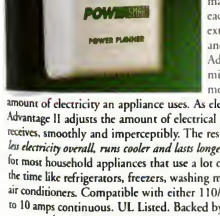
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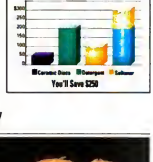


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HOME IMPROVEMENT

Installing A Hardwood Floor

New high-tech flooring offers the look of real hardwood—without the hassle.

TEXT AND PHOTOS BY MERLE HENKENIUS

● Traditional hardwood floors have long been cherished for their durability and rich, natural appearance. Unfortunately, getting one underfoot in your home takes more than most do-it-yourselfers are willing to sacrifice. In addition to some serious hammer swinging, a typical tongue-and-groove hardwood floor installation demands a practiced touch with a floor sander and edger and at least three dustfree days for applying a finish. It's not surprising that most hardwood floors are installed by professionals—and generally in new construction.

With this in mind, several manufacturers have developed hardwood-veneer planking kits that are easy to install and that all but eliminate the mess. Most of these products are designed to be glued down with mastic. However, Harris-Tarkett Inc. (P.O. Box 300, Johnson City, TN 37605) has a system that allows the entire floor to float. Harris-Tarkett's Longstrip flooring comes in packages of six laminated planks, 7½ in. wide × 95 in. long. The face veneer consists of three 2⅞-in.-wide hardwood strips, staggered to simulate the appearance of solid hardwood. The flooring is available in a variety of natural colors and is sealed with seven coats of acrylic polyurethane.

While Longstrip planks can be

glued down, we opted for what the manufacturer calls its Eversett installation. In this case, the entire floor is laid on a ⅛-in.-thick foam pad. Only the tongue-and-groove joints are glued, so the floor can expand and contract with changes in temperature and humidity. The edges are held down by the room's base trim and by a variety of reducer strips that allow the hardwood to join other flooring.

Keep in mind that ease of installation and a durable finish are this product's real advantages over a traditional hardwood floor. But don't expect to save a great deal. We paid around $670 for the materials to finish one small room of about 90 sq. ft.

Basic Installation

A floating hardwood-veneer floor can be installed over several types of substrates, including concrete and vinyl. It also accommodates slightly uneven floors. Keep in mind that vinyl and vinyl mastic installed prior to about 1982 contain harmful asbestos, and removal can release carcinogenic asbestos particles into the air. Therefore, it's often easier and safer to leave old vinyl in place.

We installed our new flooring in a small addition that had a slab-on-grade (concrete) floor. The room has a short jog in one wall and an entryway adjoining a vinyl floor. Otherwise, the installation was fairly typical. In our



1 Begin by covering concrete floor with a sheet of 6-mil. plastic. This barrier helps keep the underside of the planks dry.



2 Roll out the ⅛-in.-thick foam-rubber pad from wall to wall. Butt and tape adjoining pieces—don't overlap edges.



3 Place plywood spacers against the wall. Set the first plank against them with the grooved edge facing the wall.



4 Apply glue to the next plank's groove in 8-in. sections. Allow 12-in. spaces between the sections of glue.

case, the baseboard was already installed, so we used the base shoe to cap the flooring perimeter. For a larger room, remove the baseboard to allow for greater expansion. A ½-in. expansion allowance is usually recommended, but a larger room may need a greater perimeter gap.

Moisture control is a key part of any wood flooring job—just a few ounces of water beneath the sealed surface can buckle tongue-and-groove joints. If you're working on a basement floor, for example, and your basement has had moisture problems, almost any other flooring product is a better choice than wood. Even surface condensation on an above-grade concrete floor can mean trouble, so every wood-over-concrete installation begins with a wall-to-wall layer of 6-mil. plastic sheeting. When practical, bring the plastic up the wall slightly (Photo 1). If your plastic sheeting is not large enough to cover the entire floor in one piece, overlap all joints at least 8 in.

With the plastic in place, roll out the ⅛-in.-thick foam-rubber pad so that it reaches the walls on all sides (Photo 2). Where piecing is required, butt the edges and secure them with carpet tape. Next, set wood spacers along the starting wall, beginning and ending about 16 in. from the corners. We used ¼-in. plywood to provide the overall ½-in. expansion allowance. Then, lay the first plank in place against the spacers, with the grooved edge facing the wall (Photo 3).

In spaces longer than the length of a single plank, cut every other piece so that the ends are staggered and offset by at least 2 ft. In a smaller area, simply cut the planks to fit. To avoid splintering the veneer surface when cutting, keep the finished side down if you're using a circular saw or sabre saw, and the finished side up when using a handsaw.

After the first plank is in place, trim the next plank to length and set it upright near the first plank, with the groove facing up. Then, using the manufacturer's yellow glue, fill the groove for 8 in., skip 12 in. and then apply glue on another 8 in. (Photo 4). Continue this sequence along the plank's entire length.

Lay the glued plank against the previous plank, align the ends and press the tongue and groove together. Then, using a small block of wood to protect the plank edge, tap the joint together with a hammer. Repeat this procedure every 24 in. along its length (Photo 5). When the joint is closed, move to the next plank. As you assemble the floor, some of the glue will squeeze out onto the finished veneer. When this happens, wipe it away quickly with a damp rag (Photo 6).

When joining planks end to end, be sure to use plenty of glue. In this case, it's less messy to glue the tongue just before fitting the long joint (Photo 7). When you reach the last piece, rip the plank to fit (Photo 8).

To seat a tongue-and-groove joint when a ripped plank abuts a wall, place a plywood spacer against the wall and lever against it with a small pry bar until the joint is closed (Photo 9). The spacer will also help ensure an adequate perimeter gap.



5 Press the tongue-and-groove joints together and tap closed with a hammer and wood block. Tap every 24 in.



6 Use a damp rag to wipe away any excess glue that is forced to the surface. Clean each joint before moving on.



7 Glue the ends as well as the edge joints. It's less messy to do the ends last and to apply the glue to the tongue.



8 Rip the last plank to fit. When using a circular saw or sabre saw, keep the finished side of the plank down.



9 Use a pry bar and a plywood spacer against the wall to lever the last plank tight against the previous one.

Transitions And Trim

While gluing and laying down the planks is pretty simple work, a transition with an adjoining floor requires careful planning. Harris-Tarkett offers a variety of hardwood transition pieces called reducers, which are similar in function to thresholds found in traditional flooring. The nature of your doorways or openings and the existing flooring will determine how you use these reducers.

For example, if you have carpeting that stops short of the centerline of the opening, you may need to extend the planking and reducer to meet it. If, on the other hand, you have ceramic floor tiles that reach well across

the centerline, you may need to stop the planks short to be able to accommodate the transition piece.

And finally, if you run the planking through a doorway and into an adjoining room, you'll need to undercut the doorjamb to conceal the planks' edges. While these obstructions may require a little extra thought, the solutions are simple enough. As long as you buy the right reducer (made in varying profiles and depths for tile, carpeting, vinyl and other floor types), the transition should be relatively easy. Your dealer will be able to help.

When making the transition from planking to vinyl through a simple entryway, such as ours, extend the planks ⅝ in. into the opening, as measured from the face of the baseboard. Then, glue and tap the last plank into place (Photo 10). Once the reducer is installed, its edge will be flush with the baseboard. After you've planked across the opening, cut the reducer to length and set it in place over the edge of the planking.



10 Prepare for the reducer designed to join vinyl floors by installing the last plank so it extends ⅝ in. beyond the base trim.



11 Using the reducer as a guide, cut through the vinyl flooring with a utility knife and then remove the cut section.



12 To secure the reducer to a concrete floor, apply flooring adhesive to the exposed area with a notched trowel.



13 Press reducer into adhesive and weigh it down until the adhesive sets. Don't secure the reducer to the planks.



14 Finish the vinyl side with a short piece of base shoe and set the nails. Predrill the shoe to avoid splitting it.



15 Begin installing the base shoe over the new floor at the opening. Cut the shoe end square and then chamfer the corner.



16 Apply a bead of latex-adhesive caulk to the joint between vinyl and reducer. Wipe away excess with a damp cloth.

The next step is to remove the section of vinyl flooring that falls under the reducer. Using the overlapping edge of the reducer as a guide, cut through the vinyl with a utility knife (Photo 11). Next, lift out the cut section of vinyl and apply flooring adhesive to the exposed concrete with a notched trowel (Photo 12). Press the reducer into the adhesive and weigh it down until the adhesive sets (Photo 13). A setting time of a couple of days is best. If your installation is over a wooden subfloor, you don't need to use any adhesive. Just nail through the reducer with finishing nails and set the heads.

With the reducer in place, cut a short piece of base shoe for the vinyl side of the wall. Prebore and nail it into place so its end butts against the edge of the reducer (Photo 14). Then, cut and install the base shoe for the planked side of the wall, starting at the side of the opening. Trim the exposed end of the shoe molding by first cutting the piece squarely to length. To give the exposed end of the base shoe a finished appearance, cut a 45° chamfer across the stock (Photo 15).

And finally, to protect the vinyl edge, caulk the joint between the vinyl and reducer with latex-adhesive caulk. Just apply a bead of caulk along the seam (Photo 16) and wipe away the excess with a damp cloth. When you've finished, only a thin line of caulk should remain. **PM**

TOOL TEST

Harris Lapping System

TEXT AND PHOTOS BY ROSARIO CAPOTOSTO, Contributing Editor

● If you've always thought that lapping was a process reserved for high-precision machine-shop work, or if you've never given it any thought at all, it may be time to expand your horizons. Hand-lapping is a proven method of maintaining and sharpening woodcutting tools. And, with the introduction of the Harris Lapping System, the technique is now available to anyone who's interested in achieving a razor-sharp edge.

Hand-lapping is a grinding process, somewhat akin to sharpening on a whetstone. However, in place of the traditional stone that's made up of bonded abrasive grit, lapping uses a metal plate on which loose abrasive grit is sprinkled.

The Harris Lapping System includes two precision-ground, double-annealed, gray cast-iron lapping plates. One plate is grooved on both sides for rough lapping. The other has a smooth finish and is used for fine lapping. A heavy cast-aluminum holding tray provides a firm, no-slip grip on the plates. The system also comes complete with a supply of 280- and 600-grit silicon carbide, 2- and 10-micron diamond compounds and a special lapping oil.

We tested several plane irons and chisels that were in poor condition. After charging the grooved plate with 280-grit silicon carbide, we effectively flattened the backs and reshaped the bevels on the cutting tools, using the Harris system. However, the job is by no means instantaneous—it requires effort and plenty of elbow grease. A second lapping on the opposite side of the plate with 600-grit particles further sharpened the tools. By using the smooth plate and diamond compounds, the cutting edges were brought to a mirror finish.

The test results were quite good, and compare well with traditional sharpening methods. In addition, lapping on a metal plate has a few distinct advantages. First, the plates are ground flat to within .0002 in.—far flatter than standard stones. And the plates maintain their flatness, whereas stones, to a greater or lesser degree, tend to wear out during the sharpening process.



Lapping utilizes a metal plate and abrasive grits. Here, a chisel back is flattened with coarse silicon-carbide grit.



The Harris system comes with two steel plates, an aluminum tray, lapping oil and silicon-carbide and diamond abrasives.



After rough lapping, use the smooth plate for finishing. Just a small amount of diamond compound should do the job.



Back-and-forth strokes with light pressure will produce a keen edge. Renew the abrasive once the cutting action stops.



After the final lapping has been completed, the finished cutting edge features a clean, flat bevel that's polished to a mirror finish.

On the other hand, at about $190, the Harris Lapping System is not cheap. It's available from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013. PM



SHOP PROJECT

Mission Lamp

How to build a classic, solid-oak table lamp.

BY ROSARIO CAPOTOSTO, Contributing Editor

● Here's a lamp you can build that's got it all. It's small enough that you can make it in a weekend or two, and it won't break your woodworking budget. Plus, its clean design fits just about any decor.

However, its simple appearance won't leave you unchallenged in the shop. The shade consists of a wood frame that houses stained-glass panels. Because it's based on a truncated pyramid, your table saw's mitering and beveling capabilities will get a workout. While we made our lamp out of oak, any hardwood will do.

The hardware is available at stores that sell lighting and electrical supplies. For the shade, we used Wissmach Opalescent glass in a ginger color. If you have trouble finding a stained-glass supplier in your area, you can contact Hudson Glass Co., 219 North Division St., Peekskill, NY 10566. This company can provide glass similar to the type we used, or in a style and color of your choice.

Lead photo: J.R. Rost
Step-by-step photos: Rosario Capotosto
Technical art: Eugene Thompson
Photo stylist: Gabe Herrick

Cutting The Shade Pieces

Begin by planing oak stock to ⅜ in. thick for the shade frame components. Then, rip and crosscut the eight corner pieces oversize in width and length—about 1¼ × 14 in. Tilt the table saw blade to 30.3° and rip a bevel on one edge of each piece to bring the strips to exact width (Photo 1). Save the waste for making the shoulder pieces that reinforce the corner joints. Smooth the sawn edges.

With the table saw miter gauge to the left of the blade, adjust the miter-gauge angle counterclockwise to 55°. Attach a 20-in.-long auxiliary fence to the miter gauge, and return the saw blade to the 90° setting. Crosscut one end of four corner pieces with the square edge held against the auxiliary miter gauge fence. Make sure the bevel is facing up. Then, crosscut one end of the remaining four pieces with the bevel facing down.

To cut the corner pieces to exact length, first clamp a stopblock to the auxiliary fence. Leave the miter gauge at its 55° setting. Bevel the stopblock to match the ends already cut, and locate the block to achieve 12⅝-in.-long pieces. Then position each workpiece with its beveled edge against the miter gauge fence to produce cuts parallel to the original end cuts (Photo 2).

Next, rip ⅜-in.-thick stock for the top and bottom crossmembers to ⅞ in. wide. Rough cut the top pieces to 7 in. long and the bottom pieces to 20 in. long. With the table saw blade set for a 30.3° bevel and the miter gauge set at 55°, cut the compound angles on one end of each piece. Then, swing the miter gauge to the opposite 55° mark and cut the remaining ends to length.

To cut the half lap joints, readjust the saw arbor to 90° and install a dado blade set for a 3⁄16-in. depth of cut. Lay out the half lap joints on the corner pieces and crossmembers, and cut them with the miter gauge set at 55° to the left or right, as required. Again, use a stopblock clamped to the miter gauge auxiliary fence to ensure uniform cuts (Photo 3).

Glue together the waste strips that were produced when ripping the edge bevels on the corner pieces. Orient them in mirror-image pairs, mating the sawn edges. When the glue is dry, trim them to the profile shown in the Corner Assembly detail. Then, prepare four ⅛ × 1-in. strips for the glass retainers and four ⅜-in.-sq. strips for the bottom shoulders. To cut the retainers and corner shoulders to length, first assemble the shade frame and then trim the pieces to fit.



1 Use a pushstick to rip the corner strips with the saw blade set at 30.3°. Featherboard holds work against rip fence.



2 Cut corner strips to length with miter gauge at 55°. Stopblock at end of auxiliary fence ensures uniform lengths.



3 Use a dado blade set at 90° to cut the half lap joints. Stopblock clamped to fence accurately positions the notch.

Shade Assembly

Because of the shade's shape and the small size of the pieces, it's impractical to use clamps to hold the parts together. But ordinary masking tape will do the job, provided the joints are accurately cut and fit.

Begin the lampshade assembly by gluing the half lap joints to create four separate trapezoidal frames. Apply glue sparingly to the half lap joints, and use masking tape to hold the subassemblies until the glue sets (Photo 4). When the glue is dry, remove the tape and lay the frames edge to edge on your workbench with the outside surfaces facing up. This will leave one joint open. Apply masking tape along each joint line between adjacent frames (Photo 5).

Carefully flip the assembly over and use a small brush to apply glue to all the beveled mating surfaces. Fold the frames together and use tape to hold the last, open joint together (Photo 6). Let the glue dry before removing the tape.



4 After applying glue sparingly to half lap joints, use masking tape to apply pressure and hold work until glue sets.



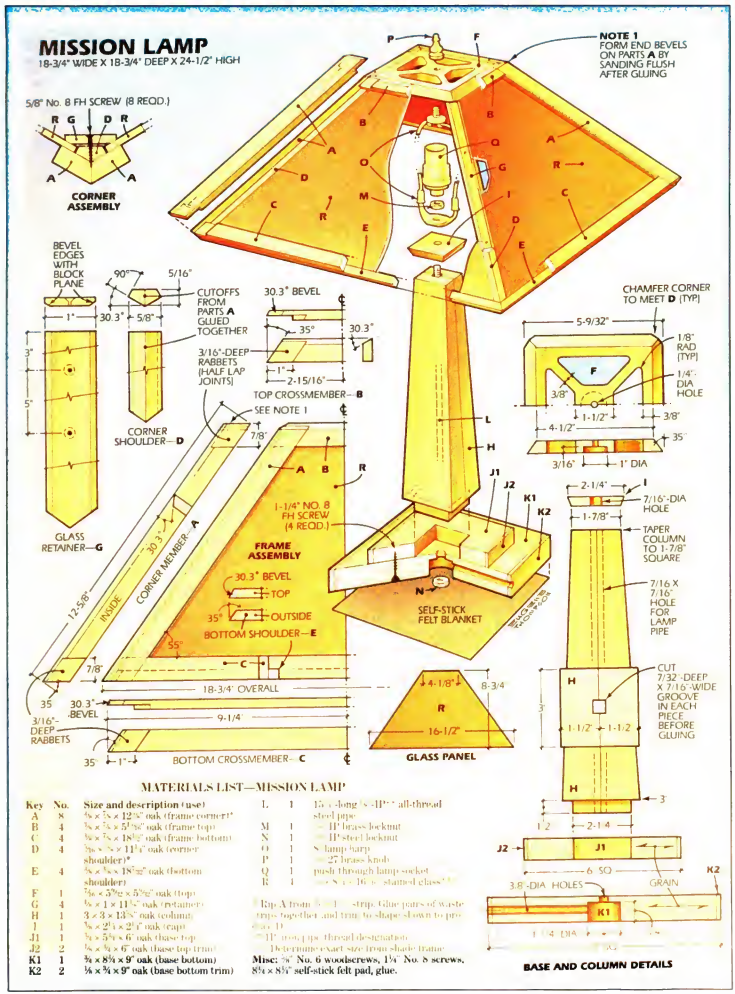
5 Lay frames outer face up. Apply strips of tape over adjacent joint edges. Flip the assembly over and apply glue to bevels.



6 Fold the four frames together to close the bevel joints. Wrap masking tape around the fourth joint and let glue dry.

MISSION LAMP

18-3/4" WIDE X 18-3/4" DEEP X 24-1/2" HIGH



MATERIALS LIST—MISSION LAMP

Key	No.	Size and description (use)
A	8	⅞ × 3⅝ × 12⅜" oak (frame corner*)
B	4	⅞ × 3⅝ × 5⅛" oak (frame top)
C	4	⅞ × 3⅝ × 18½" oak (frame bottom)
D	4	⅞ × 3⅝ × 11¼" oak (corner shoulder)*
E	4	⅞ × 3⅝ × 18⅝" oak (bottom shoulder)
F	1	⅞ × 5⅞ × 5⅞" oak (top)
G	4	¼ × 1 × 11⅝" oak (retainer)
H	1	3 × 3 × 13⅝" oak (column)
J	1	⅞ × 2½ × 2½" oak (cap)
J1	1	⅞ × 5¼ × 6" oak (base top)
J2	2	⅞ × ¾ × 6" oak (base top trim)
K1	1	¾ × 8¾ × 9" oak (base bottom)
K2	2	⅛ × ¾ × 9" oak (base bottom trim)
L	1	16"-long ⅛-IP* all-thread steel pipe
M	1	⅛-IP brass locknut
N	1	⅛-IP steel locknut
O	1	¼ lamp harp
P	1	2" brass knob
Q	1	push-through lamp socket
R	4	5" × 16" × 16" stained glass**

Misc: ¾" No. 6 woodscrews, 1¼" No. 8 screws, 8½ × 8½" self-stick felt pad, glue.

*Rip A from 5⅞"-wide strip. Glue pairs of waste strips together and trim to shape shown to produce D.

**Determine exact size from shade frame.

Finishing The Shade

Crosscut the bottom shoulder pieces to fit inside the assembled frame with compound angles at each end. Then glue the pieces in place.

Make the square lampshade roof out of stock planed to 7/16 in. thick, and bevel the edges to 55°. Trim each corner to allow room for the square upper ends of the corner shoulders.

Make the roof cutouts by first boring ⅛-in. holes at the cutout corners. Remove the waste with a sabre saw or scroll saw, and sand smooth. Bore the hole and then counterbore for the lamp harp as shown in the drawing.

Bevel the lower ends of the corner shoulders to meet the bottom shoulder strips, and cut the upper ends square to fit against the beveled corners of the top. Secure the shoulder strips and lampshade top with glue (Photo 7). When the glue is thoroughly dry, bevel the upper edges of the frame by sanding them flush with the top.



7 After cutting the beveled edges of the roof to fit frame, apply glue and secure with spring clamps until the glue dries.



8 Fit the glass retainers and bevel the edges to bear against the glass. Install with ⅝-in. No. 6 fh woodscrews.

Double-check the space for the glass panels, and make a cardboard template that fits the frame openings. Take the template to your glass supplier to get the panels cut to exact size and shape. With the glass on hand, fit the retainer strips and bevel the edges with a hand plane as shown in the glass retainer detail. Screw these to the frame, and check that the parts fit properly (Photo 8). Then, remove the retainers and stained-glass panels in preparation for staining and finishing.

Making The Base

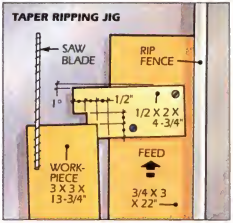
To build the column, first prepare two pieces of 1¾ × 3½ × 15-in. oak. Set up a dado blade in your table saw for a 7/16-in.-wide cut and adjust the depth of cut to 7/32 in. Then, cut a groove along the center of each piece. Clamp both pieces together so the grooves are aligned, and bore ⅛-in. alignment holes through the pieces in the waste area at each end.

Separate the halves and apply wax to the grooves to prevent excess glue from adhering to this area (Photo 9). Then, glue the halves together. Use nails in the alignment holes to position the pieces and clamp until dry (Photo 10). Joint the assembled block to a 3-in. square and cut it to exact length. Use a dado blade to cut the ½-in. tenon at one end, as shown.

Make the jig as shown in the Taper Ripping Jig drawing at right. This jig is made up of a 3-in.-wide guide board and a stepped offset block. Position the rip fence so its distance from the blade equals the combined width of the guide board and lamp column. Place the leading end of the workpiece in the notch closest to the guide board and the opposite end against the guide board itself, and cut the first tapered side. Then, rotate the workpiece to the next face and make the second taper. To cut the opposite tapers, repeat the process with the work held in the second notch (Photo 11). Plane the surfaces of the column smooth.



9 After cutting grooves along centers of column halves, apply wax to the grooves to prevent excess glue from adhering.





10 Glue and clamp halves together. For good alignment, drive nails in prebored alignment holes at waste ends of work.



11 After cutting the tenon at one end, use the taper ripping jig to cut the sides, as shown. Smooth and assemble the base.

Cut the cap and base pieces to size, and bevel the edges of the cap. Glue ⅛-in.-thick strips to the endgrain of the base pieces and bore the holes, as shown. Cut the square hole for the column tenon in the top base piece and assemble the lamp stand with screws and glue.

We finished our lamp with one coat of Minwax Golden Oak Stain, followed with two coats of Minwax Semi-Gloss Polyurethane.

When the finish is dry, install the threaded pipe and slip the lamp harp over the top of the pipe. Secure the pipe and harp with a steel locknut at the bottom of the pipe and a brass locknut at the top. Then run the wire and install the lamp socket. Secure the shade by threading the finial onto the top of the harp. PM

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Homeowners Clinic

BY NORMAN BECKER, P.E., Contributing Editor
PM Illustrations by George Retseck

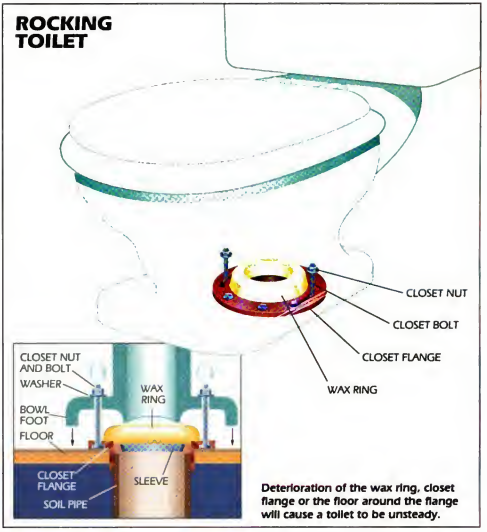
Rocking Toilet

We have a toilet that is loose on its base. I have tried tightening its hold-down nuts, but that doesn't seem to help. It's embarrassing when we have company and our guests have to use this rocking toilet. Please help.

TIM HILL
MT. PLEASANT, TX

Since you have already tried tightening the nuts, and that didn't stop the rocking, you'll have to check the area under the bowl. To do this, shut off and disconnect the water supply, flush the tank and sponge out residual water. Remove the closet nuts, and lift the bowl off the closet bolts.

Three things can be causing the problem. First, the closet flange may be loose or rusted out. Second, the subfloor around the flange may be rotted out, in which case that section needs to be replaced. Finally, the wax ring and its sleeve may be flattened to the extent that it no longer bears properly against the bowl's base, and therefore a new wax ring and sleeve must be installed.



Deterioration of the wax ring, closet flange or the floor around the flange will cause a toilet to be unsteady.

Filter Replacement

For the past few years, I've noticed that the filter on my forced-air gas furnace does not need to be cleaned or changed from one season to the next. I seem to get ample heat and cool air through the registers. Prior to this, I changed filters every month or so.

Can you tell me what would cause this condition?

R.M. BROWN
BETHEL PARK, PA

Sometimes, a change in living habits can make the air inside a house cleaner. For example, perhaps you stopped using a fireplace that occasionally let in a puff of smoke.

It's also possible that the filter doesn't fit properly and there are openings between the filter and the frame. Consequently, the dusty return air is bypassing the filter. If this is the case, you should check the evaporator coil (you imply in your

Book Review: Help With Heating Systems



● There are two things you need if your steam or hot-water heating system is giving you trouble and your heating contractor can't fix the problem: 1. A new heating contractor. 2. One of these books.

Suppose you recently had a new steam boiler installed or had modifications made to your existing boiler, or maybe your system has never worked properly at all. Consider the book on the left ($34.95 postpaid). It's a highly detailed, thoughtful and humorous look at steam systems and the ways they are derailed by lack of maintenance and improper adjustment or faulty installation of the boiler and piping. Chances are you won't be able to fix the problem yourself, but this book will give you—and your new heating contractor—some ideas. The second book ($25 postpaid) discusses hot-water circulating systems—also called hydronic systems. It functions much like the first book in that you can educate yourself in order to work with a heating contractor. An added benefit of this book is that its chapter on radiant-floor heating is the best we have seen. If you are thinking of having one of these systems installed, the book is worth it for this section alone.



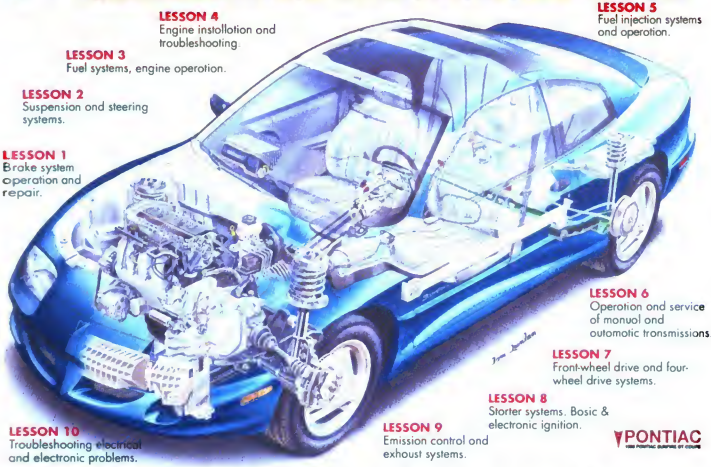
You can order both books from Dan Holohan Associates Inc., 63 North Oakdale Ave., Bethpage, NY 11714; (800) 853-8882.

—Roy Berendsohn

PM PHOTOS BY ROSARIO CAPOTOSTO

(Please turn to page 91)

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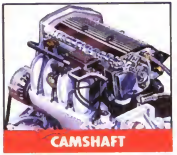


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letter that you have central air conditioning). The coil may be coated with a heavy layer of dust, which will decrease the air conditioner's efficiency.

Venting Gas Appliances

In a recent column you commented on the necessity of venting natural-gas water heaters. Why do some gas-fired appliances need to be vented and others don't? I have seen wall heaters that are not vented outside, for example.

JIM GREER
JACKSON, TN

Generally speaking, a gas appliance is vented to the outside if it produces enough carbon monoxide to pose a threat to occupants of the dwelling. Kitchen ranges, for example, are not usually vented outside because they tend to be located in well-ventilated areas. Also, they tend not to be left burning for long periods. However, there are times when even these appliances can pose a hazard, such as when people keep them burning day and night during a power outage.

Although some gas heaters are ventfree (they do not vent outside), most do require venting. It's not always easy to tell whether an appliance is vented. Some water heaters and even furnaces are referred to as direct vent. These vent directly to the outside through a short section of metal or plastic pipe.

Sun And Wind Power

I plan to build a home in Idaho, and I would like to use alternative power sources. Where can I get information?

THOM LANE
KEENE, NH

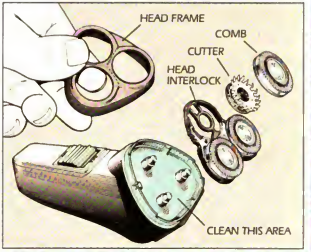
Contact the Real Goods Trading Co., 966 Mazzoni St., Ukiah, CA 95482; (800) 762-7325. The company's 650-page Solar Living Source Book *contains a wealth of information. Among other things, it explains how to generate electricity from wind and the Sun's rays, and it discusses how small-scale hydroelectric powerplants operate.*

Electric Shaver Maintenance

APPLIANCE CARE TIP

● Your electric shaver will last longer and keep giving you a good shave if you keep it clean and lubricated. The cutters on these little machines turn at very high speeds (usually about 2000 rpm). The more whiskers and debris that get behind the screen, the more friction you have. So you should clean your shaver after every use. And, periodically, really brush out the cutters and the head frame, and clean the base where the head-frame assembly mounts to the shaver. Also, the cutters move directly against their screen or comb, so it's a good idea to regularly spray the shaver with electric shaver lubricant. A final note regarding rotary-head shavers (shown): It's important to brush out the cutters moving from the back of the cutter to the front, otherwise you are likely to force debris into the little gullets along its circumference. Also, if you replace the cutters with new ones, or remove the cutters during cleaning, take care to install the cutters with their matching combs. If you don't, you'll notice a reduction in the shaver's performance. It will take several shaves for the cutters to re-sharpen themselves against each nonmatching comb.

—Sterling Frey



More On Recirculating Hot Water

The September '94 issue of POPULAR MECHANICS has what I've been looking for—a means to provide "instant" hot water in the bathroom. My problem is that I have a tankless coil in the boiler. Is it possible to install a recirculation line in this kind of a system?

PAUL ANDREWS
SCHENECTADY, NY

With a tankless coil system, the return line should be connected to the cold-water pipe that goes into the tankless coil. Do not connect the recirculation line to the hot-water supply. That would lower the temperature of the hot water.

Warped Wood Flooring

For the first time since it was installed 10 years ago, our tongue-and-groove floor has buckled. Moisture appears to have gotten under it. When it dries out, will it return to normal, or should the area be replaced?

HARRY B. WOLFE
SOUTH HADLEY, MA

First, find the moisture source and prevent it from reaching the floor again. Then let the floor dry out over the course of a heating season. When it dries out, it should return to a relatively flat position. However, you may notice discoloration, looseness and some cupping even after the floor has dried. Unless the damage is severe, replacing the damaged area should not be necessary. After loose sections are refastened and the area is sanded, the entire floor should be refinished to blend in the repair. PM

BUZZWORD ○○○ RTV

● If you're looking for a heavy-duty caulk, you might consider one that is RTV silicone rubber. RTV stands for room-temperature vulcanization. The phrase is chemists' terminology for a rubber compound that cures and solidifies when it is exposed to room temperature and moisture. These silicones exhibit high adhesion, flexibility and resistance to moisture. If you need weather and moisture resistance, as well as a caulk that adheres well to aluminum, glass or porcelain surfaces, RTV silicone is a good choice.

Although the product sounds exotic, it's not. You can get RTV silicone caulk at home centers, hardware stores and paint stores. It costs about $6 to $7 per tube. *—R.B.*

DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

Just ask Norman about it. Send your question to Homeowners Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.

NEW PRODUCTS

Mechanical Advantage

Tools to make short work out of big jobs.

BY ROY BERENDSOHN, Associate Home Improvement Editor



The Secret Of Success

One of the secrets of successful woodworking is having razor-sharp tools, and this machine seems well designed to provide that. Called the Sharpening Center, it has an 8-in.-dia. wet wheel for finish grinding and a 5-in.-dia., 2-in.-wide wheel for rough grinding to remove nicks and chips from blades. The machine is solidly built with a ½-hp motor and cast-iron base and tool holder. An accessory knife-grinding attachment (about $68) accepts planer knives up to 16 in. long. The tool costs about $210 at distributors that carry Delta machinery. For more information, write Delta International Machinery Corp., 246 Alpha Dr., Pittsburgh, PA 15238; (800) 438-2486.



Handy To Have Around

Whether it's hobby work or home repair, it's good to have a rotary tool on hand. Consider the Ryobi Multi-Tool for a moment. For $60, you get a 100-piece kit that allows you to sand, grind, drill, brush and engrave nearly any material around the home. It has a speed-control switch that is separate from the ON/OFF switch, allowing you to turn on the tool and resume work at the same speed setting you were using before you turned it off. The HT20VSK is sold at hardware stores and home centers. Write Ryobi, 5201 Pearman Dairy Rd., Anderson, SC 29625.



Tight-Fit Tool

There are times when only a close-quarter drill will work, and this product gets into more tight spots than most others. Note that it has two switches. The top one is a paddle switch intended for regular use, and it's equipped with a safety-lockout lever. The bottom switch allows extra reach. For about $415, you get the 12-volt ⅜-in. variable-speed reversing drill, two batteries, a recharger and a plastic carrying case with built-in bit storage. It's sold at power tool dealers and through tool catalogs. For more information, contact Milwaukee Electric Tool Corp., 1315 W. Lisbon Rd., Brookfield, WI 53005.

High Caliber

Freud's calibration and sanding disc is designed to improve the accuracy of your table saw while making it more versatile. The disc is a 5/32-in.-thick steel plate that is precisely ground out of high-strength steel. Its surface is said to be flat to within .001 in. Install it in place of your table saw blade and use it to gauge the distance to the fence or miter gauge. This allows for extremely accurate setup. You can augment its versatility by attaching the company's peel-and-stick abrasive discs to it, allowing you to use your table saw as a sander. It comes in 8- and 10-in. diameters ($35 and $38), and a 5-disc sanding pack costs from $14 to $24 at Freud tool dealers and through tool catalogs. Write Freud, P.O. Box 7187, 218 Feld Ave., High Point, NC 27264.



Terrific Trio

A table saw can cut only as accurately as you can guide the wood, so a good fence goes a long way toward improving the machine's accuracy and convenience. Enter the Exact-I-Rip Fence System, a $300 retrofit fence for Craftsman Contractor 10-in. belt-drive table saws (it's also offered as



standard equipment on the new 10-in. belt-drive contractor saws). The fence is an anodized-aluminum extrusion with nylon bearing surfaces. When its lever is locked, the fence is secured at the saw's front and back. Release the lever and you can remove the entire fence in seconds for large crosscuts. It slides as far as 30 in. to the right of the blade and 24 in. to the left.

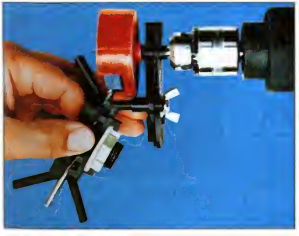
A pair of pliers is a simple tool that is hard to improve on. Still, these linesman pliers have a lot going for them. They're forged out of an extra-hard and tough alloy and clearcoated for additional rust resistance. For increased durability, the cutting blades are impregnated with tungsten carbide, and the handles are cushioned with nonslip, oil-resistant grips. The pliers are extremely well made with precisely fitting parts, and we think they're a good buy at $23. They are just one tool in the company's newly introduced line of professional pliers.

This is a real problem solver: a 34-in. floor-model drill press (about $500) with a head that tilts 45° clockwise and 90° counterclockwise. It has a maximum drilling distance from the column of about 12¾ in., and its quill travels approximately 3 in. It's powered by a 1-hp motor and 12-speed belt drive. It accepts drill bits with up to ¾-in.-dia. shanks. The articulating table is cast iron and the drivebelt tension may be adjusted using a thumbscrew.



For more information, contact Sears Roebuck and Co., 333 Beverly Rd., BC201B, Hoffman Estates, IL 60179.



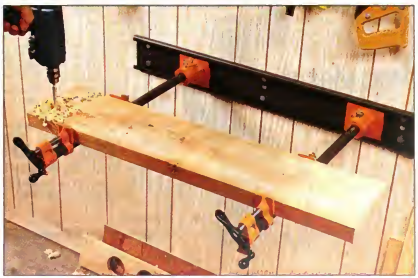


Get The Point

Chuck this device into an electric drill and you have a lightweight, compact and inexpensive drill-bit sharpener. Called the Portasharp, it grinds up to ½-in.-dia. high-speed steel drill bits and, according to the manufacturer, can put either a 90° or 118° angle on a bit's tip with the correct amount of offset. Use the 90° setting for drilling in soft materials like aluminum or wood, and use the 118° angle for drilling in steel. Its other good features include a completely enclosed drive mechanism and a wheel shroud made of impact-resistant polyethylene. It costs about $23 postage paid from Picquic Tool Co., 936 Peace Portal Dr., P.O. Box 8014-44, Blaine, WA 98230.

Off The Wall

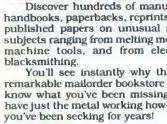
Unless you have a large, unusually well-equipped shop, clamping together glued panels can be messy and awkward. That's why this fixture is such a neat idea. Attach it to the wall with the lagscrews provided, then slide the clamp collars anywhere along the fixture and lock them in place with their thumbscrews. Thread ¾-in.-dia. pipe clamps (which are purchased separately) into the collars and you're in business. In addition to serving as a clamp for gluing panels together, the device can also function like a pair of sawhorses by holding a workpiece. Its price ranges from about $40 to $48 at hardware stores, home centers and through tool catalogs. Contact Adjustable Clamp Co., 417 N. Ashland Ave., Chicago, IL 60622.



More Than Meets The Eye

The Veritas router table looks deceptively like nothing more than a steel plate, but it's actually a sophisticated device. It consists of a flat, smooth 3/16-in.-thick plate with a router clamp mounted below. The manufacturer says all routers fit it. You simply center the base of the router so the bit protrudes correctly through the table insert, and then clamp the tool in place. You don't have to remove the router's baseplate. The plastic table inserts are 3⅝ in. in diameter and are supposed to be flush to the top, plus or minus .004 in. The inserts lock into the top with a cam action and cost $4.50 each. Two are supplied with the table: one has a ½-in.-dia. hole and the other a 1½-in.-dia. hole. The beauty of this system is that you can buy as many inserts as you want and bore or plunge cut through them so you have a zero-clearance insert for your favorite bit. Also, consider that the steel top allows you to use easily installed magnetic accessories. This way, you don't have to pepper the table with holes, as is the case with wood router tables. The top costs about $150 from Veritas Tools Inc., P.O. Box 1720, Ogdensburg, NY 13669; (800) 667-2986.





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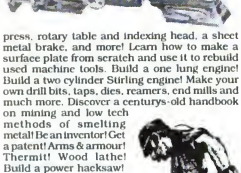
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Knockout

Black & Decker's shaper/router packs quite a punch for an inexpensive benchtop woodworking machine. For about $200 to $220, you get a machine with a FORWARD/REVERSE switch that accepts ¼-in.-dia. and ½-in.-dia. shank router bits as well as ½-in.-dia. shank shaper cutters. A shaper spindle is provided with the tool. Other features include a 2-piece fence and a 15¾-in.-wide × 18-in.-long die-cast aluminum table. The machine has a dust-collection port so you can hook it up to a shop vac for dustfree woodworking. It's sold at hardware stores and home centers. Call (800) 762-6672, or write Black & Decker Consumer Services, P.O. Box 618, Hampstead, MD 21074.

Professional Quality

The Lamello cordless plate joiner is built to be a professional cabinetmaker's or finish carpenter's tool, and its $725 price reflects this. Still, the tool is a study in how cordless technology is creeping into nearly every aspect of power tool design. The company says the tool can cut 200 plate slots on a single charge, and that it has the same features and capacities found on corded plate joiners, such as a 6-position depth stop, a fence that adjusts from 0° to 90°, a slip-proof front and hardened wear surfaces on the inner sides. Again with professional users in mind, the company offers an optional 10-minute battery recharger (which costs about $200). The charger that comes with the tool replenishes



batteries in 1 hour. According to Colonial Saw, the optional charger dramatically extends the battery's life. With the standard charger, the battery can be recharged 1000 times. With the 10-minute option, battery life is extended to 3000 charges. The Lamello Dynamic Cordless 10 is sold at woodworking tool dealers, through tool catalogs and directly through its distributor in the United States: Colonial Saw Co. Inc., 845 Milliken Ave., Suite F, Ontario, CA 91761; (800) 252-6355.

A Kinder, Gentler Contractor Saw

Heavy-duty circular saws aren't exactly known for their ease of operation. Makita's Model 5177B, however, employs a solid-state current-limiting circuit as part of its ON/OFF switch. This brings the motor up to speed gradually, preventing kickback when the saw starts. The company says the saw is relatively quiet, too—87 dbA. And another nice feature: Its drive system uses a hypoid gear (like an automotive differential), not the worm gear found in other saws. The hypoid gear is more mechanically efficient, allowing more of the 13-amp motor's torque to be transmitted to the blade instead of lost through friction. The saw's other features: Its blade pivots to 50° with a maximum depth of cut at that angle of 1½ in. The saw's base is marked with sightlines at ¼-in. intervals, and it measures 1½ in. from the blade to the left edge of the base, with ¾ in. to the right edge. The saw costs about $360 at Makita power tool dealers. For more information, contact Makita USA Inc., 14930 Northam St., La Mirada, CA 90638.



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CAR CLINIC

BY MIKE ALLEN,
Associate Automotive Editor

Running On Empty

The gas gauge on my 1981 Mercury Cougar started bouncing all over, even when the tank was full. Now the pointer sits on E all the time. I have to calculate the mileage and refill early to keep from running out of gas. How do I fix this?

RON WELZ
CERRITOS, CA

The circuit that runs your fuel gauge is pretty simple, Ron. It's a gauge in the panel and a simple wire-wound rheostat attached to a float inside the fuel tank. Either a connection has come loose or corroded, or the rheostat is bad.

Hope it's not the rheostat, and start by visually checking all of the connections on the back of the gauge and the tank. Don't forget the ground between the tank and the frame. If you have an ohmmeter or voltmeter, you can check the connections electrically, as well. The fuel-tank wiring and sender are often accessible under the rear seat.

A few vehicles may require removal of the tank. Drain it completely, as you don't want to be bench-pressing a hundred or so pounds of tank. Disconnect the battery ground, too—an empty fuel tank can still contain a highly explosive fuel-air mixture.

If you find it necessary to pull out the sender, replacing it with a new one is straightforward.

More Gas Questions

Recently, while wearing my PM "Ask Me Anything" T-shirt, someone asked me how it is that the gas-pump nozzle knows when to shut off when the tank is full?

DAVID WEBB
VIA INTERNET

Even though the flow through the nozzle is several gallons per minute, simple backpressure is enough to trigger the nozzle, which explains why some nozzles are very hair-trigger and seemingly reluctant to dispense gas. Some vehicles, because of the design of the tank, are hard to fill as well. I recall a Chevy pickup truck that had to have fuel milked in slowly for the first quarter-tank before it would take full flow.



PM ILLUSTRATION BY DON MANNES

Now We're Talkin'

I work at Bell Labs in the design of embedded microprocessor applications. I'd like to know what the interface is on the computer diagnostic port in my new GM car. I'd like to build my own interface for diagnostics, but I can't seem to get the information that I need to do this.

ED SUTTER
FANWOOD, NJ

The bad news is that the interface is proprietary, and GM won't release any information about it.

However, a number of people have reverse-engineered it, in order to develop third-party diagnostic analyzers. I doubt they would be of much help either. I'm aware of only one manufacturer that makes an interface that goes from the GM ALDL diagnostic port to a PC. It's called DIACOM, by Rinda Technologies (800-888-4146).

Water On The Brain

The halogen lights on my car keep getting moisture inside of them—not just a thin film of water on the lens,

but several ounces sloshing around inside. I'm worried that the plating on the inside of the reflector will corrode. I dry out the thing periodically, but it fills within a few weeks. I've even put silicone sealant on the O-ring to try to keep out the moisture.

HARRY BOITANO
TAMPA, FL

Obviously, condensation is building up inside the lens, no doubt due to the high humidity in Florida. The inside of the lens is supposed to be sealed, but it's not uncommon to see a thin film of moisture inside the lens on cool days. Normally, this evaporates within a minute or two when you turn on the headlights. I'd start by removing the entire housing and inspecting it for cracks or voids in the seal between the reflector and the lens.

Look for missing or misplaced shrouding that would funnel rainwater or road splash onto the housing.

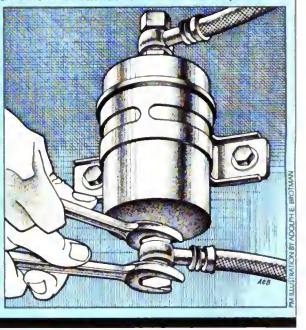
Drive around during the day with your lights on to burn off excess moisture. Try to park your car with the front end in the sun. As a last resort, drill a 1/16-in. hole in the low point of the housing to drain water.

The Turning Point

CAR CARE TIP

● Sometimes what's obvious to me isn't so obvious to other folks. And the converse as well. I had to change a fuel filter on a Volkswagen Jetta last week. It's not an unpleasant task, as the filter is in a very accessible place on the fender well, where you can reach it standing up. Actually, the owner of the car and I were working on it together, and he started on it first. He reached for his favorite tool, an 18-in. pair of water-pump pliers, to immobilize the filter while he loosened the banjo bolt. Bad idea, as the thin aluminum of the filter's housing crushed like a candy wrapper. Okay for the old filter, but no good for the new one.

I demonstrated to him the correct procedure. Many fittings like this have a set of hex flats on them, allowing you to use an open-end wrench to hold them immobile while you use a second open-end wrench to turn the bolt. Generally, each fitting requires a different-size wrench, so you don't need to duplicate your tools.



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The Egg And I

I have an '88 Chevy pickup with 105,000 miles. The brakes surge noticeably during moderate deceleration. I've replaced the pads and shoes, and turned the rotors and drums. The surging hasn't gone away. RAY FINK
JEFFERSON CITY, MO

You have an egg-shaped tire. Or a bent rim. Check the tires for roundness. The surging is caused by the differing rolling radius of the high and low portions of the tire. And there may be one or more tires involved. A good tire technician may be able to remount and rebalance a tire that's not on the rim concentrically or true a really warped tire by shaving it round.

Cool Breeze

Last summer, a weird thing happened to my new Dodge Intrepid. It was a very hot, muggy day. I drove for several hours with the air conditioning on. About 5 miles from my destination, the vent stopped blowing cold air. All the gauges were fine, and I could hear the fan running in the dash—but no air came out. An hour later, I came out to the lot to lift the hood and look for the problem. There was an enormous puddle of water under the car, but no obvious source.

I started the car and the a/c worked fine, and has since, except for an occasional musty smell. JOHN MATHENA
REDDING, CA

Your a/c evaporator collected enough moisture to freeze solid, blocking the air passing through it. This is not supposed to happen, but sometimes heavy humidity will cause it. You can avoid this problem in several ways. On humid days, run the a/c on the economy or recirculate position. This way, fresh moisture-laden air won't continually deposit water droplets on the fins, where they'll freeze. Run the fan at an intermediate position, rather than low, and run the temperature setting higher. The net effect is the same cooling for you—but the evaporator won't be so cold. A fringe benefit will be less moisture to harbor mold, and the musty smell. PM

DO YOU HAVE A CAR PROBLEM?
Just ask Mike about it. Mail your question to Car Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters, faxes, e-mail and phone calls cannot be answered individually, problems of general interest will be discussed in this column.

SERVICE TIPS

- Ford has cut fuel-filter change intervals to 15,000 miles from 22,500 on 1990 and newer Broncos, Econolines and F-Series trucks.
- Hard-to-open or scraping doors on GM's 1991-94 midsize cars and the 1995 Aurora and Riviera can be remedied by opening the lower hinges' bottom ears 2 to 4mm.
- Do you hear wind noise from your 1993-94 Jeep Grand Cherokee's/Grand Wagoneer's windshield? Dealers will fill the inner corners of the cowl with aerosol foam.
- If the heater in your BMW takes unusually long to blow hot air, a dealer can remove the sticky heater control valve and install a revised one under warranty.
- Carbon buildup causes piston slap and a cold-start knocking noise on 1991-93 Acura Legends. GM Top Engine Cleaner may help.
- A new ignition lock (PN 48700-11Y26) in your 1993-94 Infiniti J30 should restore manual and keyless door locking and kill the key-reminder chime on key removal.

FROM FRONT...



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SATURDAY MECHANIC

REPLACING YOUR TAILPIPE

BY KEN JURAN

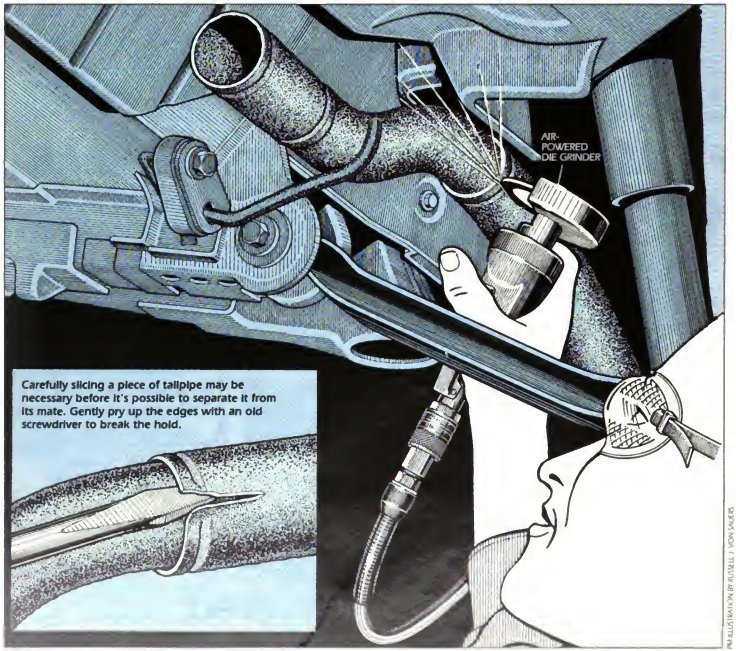
● Brakelights flicker suddenly in front of you, followed rapidly by the screeching of tires. Cars before you swerve to the left and right as you slow as safely and rapidly as practical. Despite your best efforts, the source of the pandemonium, what appears to be half of a cement block, disappears directly under your front bumper at a high speed. Thump. And as it exits from your rear bumper, you follow it in your rearview mirror for a few seconds. It has company. Your muffler—or at least most of your muffler—has apparently developed a lasting relationship with the aforementioned cement block. They're eloping at high speed toward the curb, inextricably intertwined.

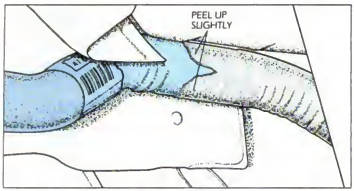
The next thing you notice is the sound of what seems to be a B-29 landing in the next lane as you press back down on the gas. Actually, it's your engine—minus its muffler—waking up again as you try to negotiate through the traffic, back home to safety, family and something tall and cold that will make your hands stop shaking.

To add insult to injury, you replaced your exhaust system from the catalytic converter back only last spring. Inspection of the underside of your car reveals good, solid pipe most of the length of the vehicle, terminating in shards of muffler. Here's your chance to replace a few feet of pipe and the missing muffler yourself.

Now that you're home

Actually, it may not be road debris that removes your muffler and tailpipe. Rust never sleeps, and cars in short-





Peel up the corners of the old pipe to slide in the new piece.

trip service may rust out the farthest, coolest portions of the exhaust system in as little as 18 months.

The following scenario is typical of vehicles that have had part of their exhaust system replaced at least once. The saga begins with a section of the original exhaust plumbing behind the catalytic converter rusting out and making a ruckus. Because the original exhaust pipes are welded together, however, all the pipes from the cat back need to be replaced. There's no practical way to remove just the rotted section because of all the welds.

If you had the wherewithal, you could probably cut out just the rusted portion and have a pipe custom-fitted. But that would be extremely labor-intensive and not particularly economical over the long haul. Also, exhaust work just isn't done that way. So, generally, two or three aftermarket pipes and the muffler are clamped together behind the converter to repair the exhaust.

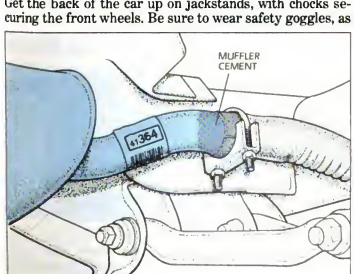
Then you drive around for another year or two in peace and quiet—unaware that the replacement pipes hanging under you tend to rust at different rates. Sometimes, the middle pipe of the three you installed goes first. Other times, the muffler at the end falls off before the other two. Still other times, the flanged pipe bolted to the cat is the first to go bad. In all cases, though, you want to replace only the bad pipe. Problem is, the pipes it's connected to at both ends have been crimped by clamps. How do you remove the Swiss-cheese pipe without ruining the other two? By using a power cutting wheel and a very steady hand. The preferred tool is an air-powered die grinder with a cutoff wheel, but a high-speed electric drill will work, albeit more slowly.

Sizing it up

Get the back of the car up on jackstands, with chocks securing the front wheels. Be sure to wear safety goggles, as exhaust systems tend to drop razor-sharp flakes of rust that are seemingly attracted to your eyes.

Get under the vehicle to see what kind of couplings you're dealing with. The flanged type is easy. Just spray the rusty bolts with penetrant oil to get them out, pry the flange from its rusty partner and secure the new flange with a new gasket and fresh bolts. Use antiseize compound on everything to ease removal the next time.

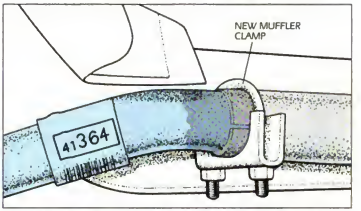
The other type of coupling is made up of a larger pipe slipped over a smaller one or a smaller pipe slipped into a larger one, depending on which way the coupling is facing. Both may be present in the same exhaust system. The important thing to remember is that you may need to save the inner pipe, so use a gentle touch with the cutting wheel. If the outer pipe needs to be saved, there's nothing you can do to keep from cutting it. But that's why you're going to use a cutting wheel instead of an impact chisel. It makes for a neater, smoother cut.



Smear muffler cement over the joint after you install the clamp.

Slice, don't dice

To begin, remove the bad pipe's clamps. Then, make a lengthwise mark 1 to 2 in. long where you want to slice open the outer pipe. Put on a pair of goggles, get a good double-handed grip on the cutter tool and start it up. Slowly raise the spinning wheel to the mark on the pipe. With gentle pressure, score the mark.



After installing all the parts, adjust for fit and tighten the clamps.

If you're saving the inner pipe, repeat this step until you're through the outer pipe. It's okay for the inner pipe to get a little score groove in it—just as long as you don't cut it all the way through. If you're saving the outer pipe, the second cut can take you all the way through the inner pipe.

With the cut made, use a screwdriver or a chisel to pry open the outer pipe like a tin can. That will give you enough play at the crimped area to wiggle the pipes apart.

Spread 'em

Fitting a new pipe over an old one is no problem. Fitting a new pipe into an old one sometimes is, because of the crimp from the old clamp. If you're having trouble, use an exhaust-pipe expander to gain some extra clearance. Then, simply fit the pipes together as if they were both new and smear a little muffler cement on the joint.

If you saved the outer pipe, it now has a 1- to 2-in. slice at the end. Make sure to slide the inner pipe in past the end of the cut, so there's no hole between the pipes. Install a new muffler clamp, but don't tighten it until the rest of the system is hung from the hangers and aligned properly.

Once everything is back together and clamped down tight, a little muffler cement strategically applied with your thumb over the cut will take care of any tiny residual gaps. Lower your car and enjoy the silence. **PM**

PM ILLUSTRATIONS BY RON CARLSON

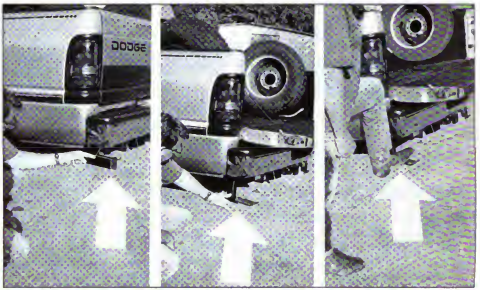
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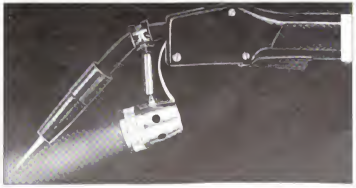
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Towing Mirror

Part of the towing routine has typically required installing extended mirrors on your tow vehicle for proper rear vision. Large, ungainly looking mirror brackets had to be either screwed into or strapped to the body, which required drilling holes or otherwise marring the finish. The Tailored Towing Mirror is a better way. It simply slides over the existing van, pickup or sport/utility outside mirror, and adds 6 in. to your view to eliminate blind spots. The mirror can be pulled off easily when not needed. You can find the towing mirror at Western Auto Supply outlets for about $30. For more information, contact Nice One International Development Corp., 18003 Cortney Ct., City of Industry, CA 91748; (818) 965-2828. PM



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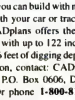
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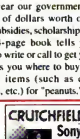
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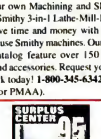
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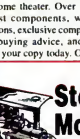
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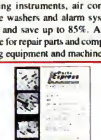
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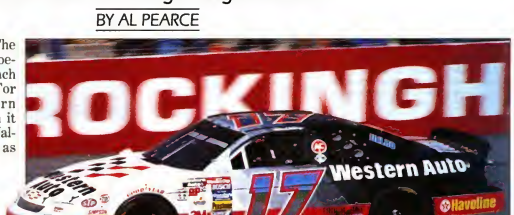
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The Sun sets on a tough-fought season.

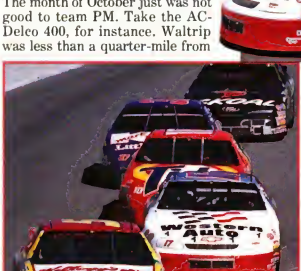
BY AL PEARCE

● As we go to press, it's all over. The 31-race Winston Cup season that began last February at Daytona Beach ended in November near Atlanta. For Darrell Waltrip and his Western Auto/POPULAR MECHANICS team it was a long, hard road. Happily, Waltrip and crew ended the season as hopefully as they began it.



AC-Delco 400

The month of October just was not good to team PM. Take the AC-Delco 400, for instance. Waltrip was less than a quarter-mile from



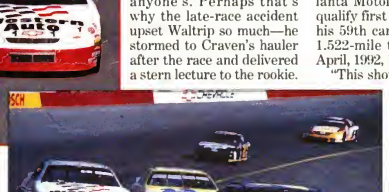
PM PHOTOS BY DON HUNTER

Waltrip showed that he could race right up to the season's end. At Rockingham (above), he's tucked between Ricky Rudd's Ford and Terry Labonte's Chevy. At Phoenix (right), he runs with Winston Cup champ Jeff Gordon.

an eighth-place finish at the Rockingham, North Carolina, track when he and Ricky Craven wrecked, much like they did at the previous race at Charlotte.

The Western Auto/POPULAR MECHANICS team had been struggling from the beginning with chassis problems. The No. 17 Chevy Monte Carlo was too loose. On a 1-mile track with lap times of about 24 seconds, it doesn't take long for an ill-handling car to fall behind.

Waltrip was lapped early, then unlapped himself near the halfway point as his crew found a better chassis combination. After that the car was as fast and stable as anyone's. Perhaps that's why the late-race accident upset Waltrip so much—he stormed to Craven's hauler after the race and delivered a stern lecture to the rookie.



Dura-Lube 500k

Few drivers handle the Phoenix International Raceway as well as Waltrip. In the seven races scheduled at PIR since 1988, Waltrip has had six top-10 finishes.

But the streak ended when Waltrip started 21st and later lost engine oil pressure. He parked the race car with 81 miles left in this fall's Dura-Lube 500-kilometer (312-mile) race.

NAPA 500

Waltrip and the Western Auto/PM team saved their very best for the very last race. The season-ender at the Atlanta Motor Speedway saw Waltrip qualify first for the NAPA 500. It was his 59th career pole, his first at the 1.522-mile track and his first since April, 1992, 113 races ago.

"This shows what we can do," Waltrip said after his 185-plus mph lap. "We know we've got good cars, good engines and good people. The team has worked so hard, trying for something good like this to happen."

Waltrip felt the pressure as qualifying drew near. "The car was really fast, so it was up to the driver not to mess up. I'm used to pressure like that, but I haven't faced much of it lately."

Waltrip led the first lap of the 328-lap race before settling in among the top five. He stayed close enough to the front to lead twice more before eventual race-winner Dale Earnhardt lapped most of the field right around

(Please turn to page 110)

PM PHOTO (BOTTOM) BY DON HAMMANN

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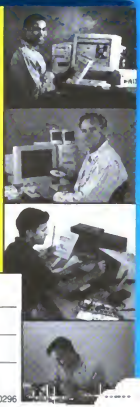
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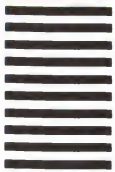


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DE-ICING THE PUCK

(Continued from page 55)

Mission Roller Hockey's BiltRite line of protective gear is constructed using the company's Coolness system, which features genuine and synthetic leathers lined with DuPont's Coolmax material. In addition, Mission's shinguards use DuPont's Aquator moisture-wicking liners.

To be a player, you have to look like a player. With jeans and long-sleeve jerseys no longer cutting it, specifically designed apparel is being worn on the asphalt. Short sleeves, mesh vents and tapered looks are crossing over from the basketball courts to the hockey rinks. Easton offers a short-sleeve game jersey made of lightweight polyester mesh for ventilation, and Dodger targets off-ice skaters with a baggy mesh jersey and matching shorts.

Now rolling with the proper protective and comfort measures, off-ice players look for other performance edges, and the next tool of the trade they usually turn to is the stick. If you are one of the oldtimers who can remember having to bend back a plastic stick after getting tangled between defensemen, you'll really appreciate the advances made in stick and blade technology. Today, sticks made with wood or higher-end materials such as aluminum or graphite dominate the playgrounds. Easton's new Pro Axis aluminum stick ($49.99), for example, features the ABS Extreme blade, which is constructed of a high-grade hickory hozel, reinforced glass and two fiberglass laminations.

In addition to sticks that can stand up to outdoor play, manufacturers are also offering interchangeable blades that can be customized to match the playing surface. Louisville's LocJaw Azdel blade ($17.95) features a tapered-screw set designed to attach to the stick quickly and without the standard torching process.

Even the old rubber ball that used to be a staple of street hockey is obsolete. For every playing surface, there are a variety of pucks and nonbouncing balls specially designed for off-ice play. For example, Sun Hockey's Hot Pucks line includes the Zero Bounce ball, as well as surface-specific pucks like the Rough model for street games and the Arena for indoor league and tournament play.

The flooding of the market with advances in product design is spurred by research that shows the number of off-ice hockey players is steadily increasing. So, for all those frustrated tennis players who were hoping that roller hockey's power play would be a temporary fad, it may be time to put down your racquet and pick up a stick—fiberglass, of course. **PM**

MIND CONTROL

(Continued from page 67)

Company president Ron Fone, whose reputation was made as an Atari executive 10 years ago, says the finger sleeve measures a variety of signals produced by the brain. These include amplitude, velocity, attenuation or size of the signal, asymmetry of two different signals, phasic or rate of change, and tonic or absolute measurement of the signals.

Fone describes the process as akin to the visualization routines many athletes employ before actually participating in an event. During this visualization process, electrical signals are sent to the appropriate muscle groups even if no actual activity is occurring. These signals can be captured and translated to control devices. Fone intends to relay these signals wirelessly to a receiver connected to a videogame console. The first-generation product, however, may use a wired relay.

As I demo a wireless prototype of MindDrive, I find Fone's description of the process accurate. In one skiing simulation, I am able to control a downhill skier simply by thinking "right" or "left." The better I visualize actually skiing, the more control I have. It probably helps that I'm a skier.

Another MindDrive demo reveals what might loosely be described as my mind painting skills. On the screen is an outline of a human head. Fone asks me to think about something that makes me angry. I do and the image on screen turns a hot red. When prompted to think happy thoughts, the image turns placid blue.

Interestingly, the mental gymnastics I use to run MindDrive seem different from the techniques I used to control the IBVA device, although I can't say exactly how.

Fone plans to market a series of MindDrive software programs that will focus on games, education and performance enhancement. *ArtMind*, for example, lets you draw or color on the screen using your thoughts.

Mind control is entertaining and possibly beneficial, but is it potentially dangerous as well? That's hard to predict. While direct mind-to-mind manipulation is still in the realm of science fiction, the use of mind control to operate devices may be subject to abuse. IBVA envisions a "superlearning" application in which people learn quicker and with better retention in a more relaxed state. A leap of the imagination might produce brainwashing scenarios. On the other hand, it may be no more malign than some existing diet programs.

Like other past innovations, mind control is a new tool that we may soon have to learn how to use best. **PM**

MOTORSPORTS

(Continued from page 106)



PM PHOTO BY DON HUSTON

After losing oil pressure at Phoenix, Waltrip contemplates the long season.

the race's halfway mark.

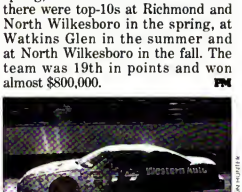
Still, Waltrip fully expected a solid top-10 finish until his No. 17 Chevy began slowing in the final laps with an electrical problem. He was lapped in the final moments and finished a frustrating 16th, three laps behind.

"We had a great car, but it started losing power when something in the electrical system quit," Waltrip said. "I'm disappointed because I thought we could win the race."

Three days after Atlanta's season finale, Waltrip underwent successful surgery in Daytona Beach. After more than five years with a steel rod and other hardware in his leg—compliments of a 1991 crash—Waltrip decided to have it removed.

The long-planned surgery underscored Waltrip's commitment to race in the foreseeable future. He turns 49 in February—that's already nine years longer than he planned to race—but sees no reason to quit while he's relatively healthy and capable of getting the job done.

The final NASCAR standings don't reflect how well Waltrip's team performed during 1995. In 31 starts, they had one pole, top-5 finishes at Bristol, Martinsville and Talladega in the spring, and at Bristol in the fall. And there were top-10s at Richmond and North Wilkesboro in the spring, at Watkins Glen in the summer and at North Wilkesboro in the fall. The team was 19th in points and won almost $800,000. **PM**



PM PHOTO BY DON HUSTON

The Sun's not setting on Waltrip yet. He won the pole and led the NAPA 500.



EUROPEAN DOCTORS PROVE THAT MANY

Prostate Disorders Can Be Corrected or Prevented

Recently actor Bill Bixby and musician Frank Zappa died of prostate cancer. They were only in their fifties! Doctors say that most men over 60 have some degree of prostate disorder—and it is not unusual for men in their forties and fifties to have minor prostate problems.

Dr. Sidney Snow, M.D., and a world famous urologists said, "Drugs and surgery were not doing the job I was taught that they would do. Other scientists agreed and continued to look for a better solution. Finally we have found a natural approach to treating and preventing prostate disorders that is safe and works."



Have To Get Up At Night?

Do you have to get up at night to urinate, feel urgency, delay or dribbling at other times? Well, these are the first signs of a prostate disorder. Do you feel pain or discomfort when urinating? If so, the disease may have advanced.

May Cause Impotence!

Until just a few years ago, surgery was the only choice for prostate disease, but it was a horrible one! A sizable percentage of men became impotent as a result, and at best the surgery only postponed the problem for a few years.

The highly touted prescription drug currently available has had limited success. The common side effect is sexual dysfunction—not a welcome alternative.

A Better Solution

An amazing medical breakthrough has been made in Europe that promises to put an end to many prostate disorders. 38 of Europe's most prominent medical scientists conducted double-blind studies in France, Germany, Switzerland and Italy at 13 hospitals.

The doctors tested an extract from the bark of an African tree on over 600 patients who had various stages of prostate malfunctions.

"My doctor wanted to operate on me. However, I decided to try Pymoxin first. I'm glad that I did. They eliminated all the problems I was having. You save me a lot of pain and a big medical bill. Thanks!"
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High Success Rate

A high percentage of the participants receiving the extract were relieved and astoundingly no side effects were detected. Most men were able to regain their normal sexual functions in a short time.

After the distinctly positive results were published in several leading medical journals, American urologists and medical scientists tested the substance on numerous patients with prostate disorders here in the United States. Their results concurred with those of the European doctors.

No Prescription Necessary

The fact that this powerful extract produces no side effects is remarkable especially in light of the fact that all surgical techniques and current drugs do. This substance does not require a prescription, is inexpensive and is now available in the United States.

ATTENTION DOCTORS: The research data that substantiates the effects of this formula is available to all licensed medical professionals. Just send the request on your letterhead. It will be sent to you by return mail at no charge.

Prevention Is Possible

Up until the 1950's, the percentage of men afflicted with prostate problems was nearly 50% less than it is in the 1990's.

Scientists believe that one cause is the lack of particular mineral which we normally get from several vegetables. The prostate needs 10 times more of this mineral than any other organ in the body.

The problem is that vegetables today have very low levels of that mineral because chemical fertilizers do not replace it in the soil. Prior to the 1950's, organic fertilizers were more commonly used which replaced the mineral keeping prostate disorders at bay for greater number of men.

In Japan, where farmers refuse to use chemical fertilizers, men have 85% less prostate problems than men in the U.S.

Many scientists have proven in rigid double-blind clinical tests that supplementing your diet with that mineral and the bark extract mentioned earlier can reverse may prostate problems and prevent the progression of others.

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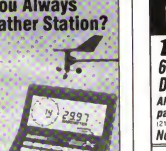


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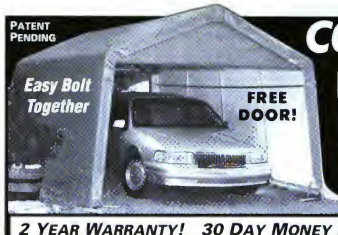
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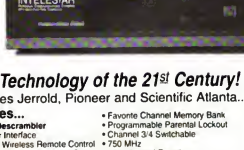
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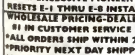
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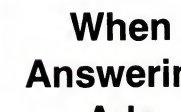
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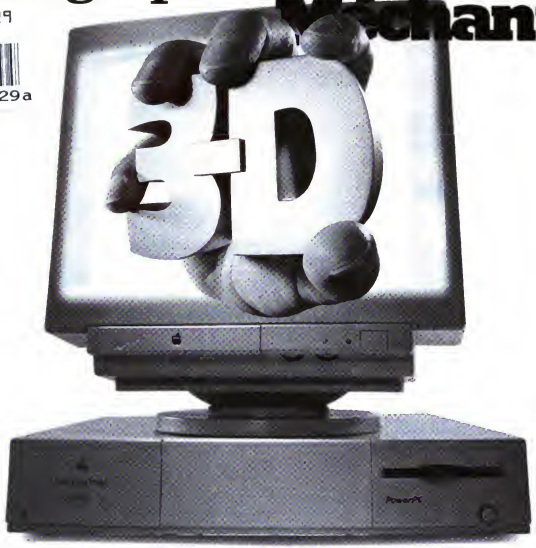
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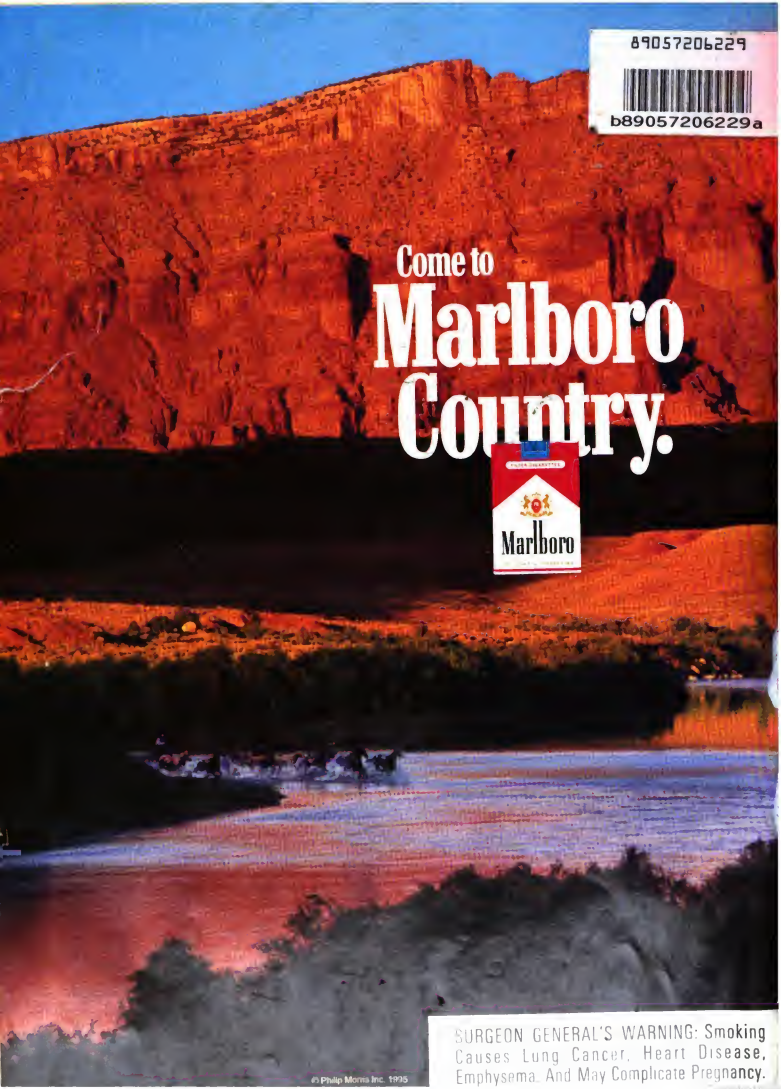
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